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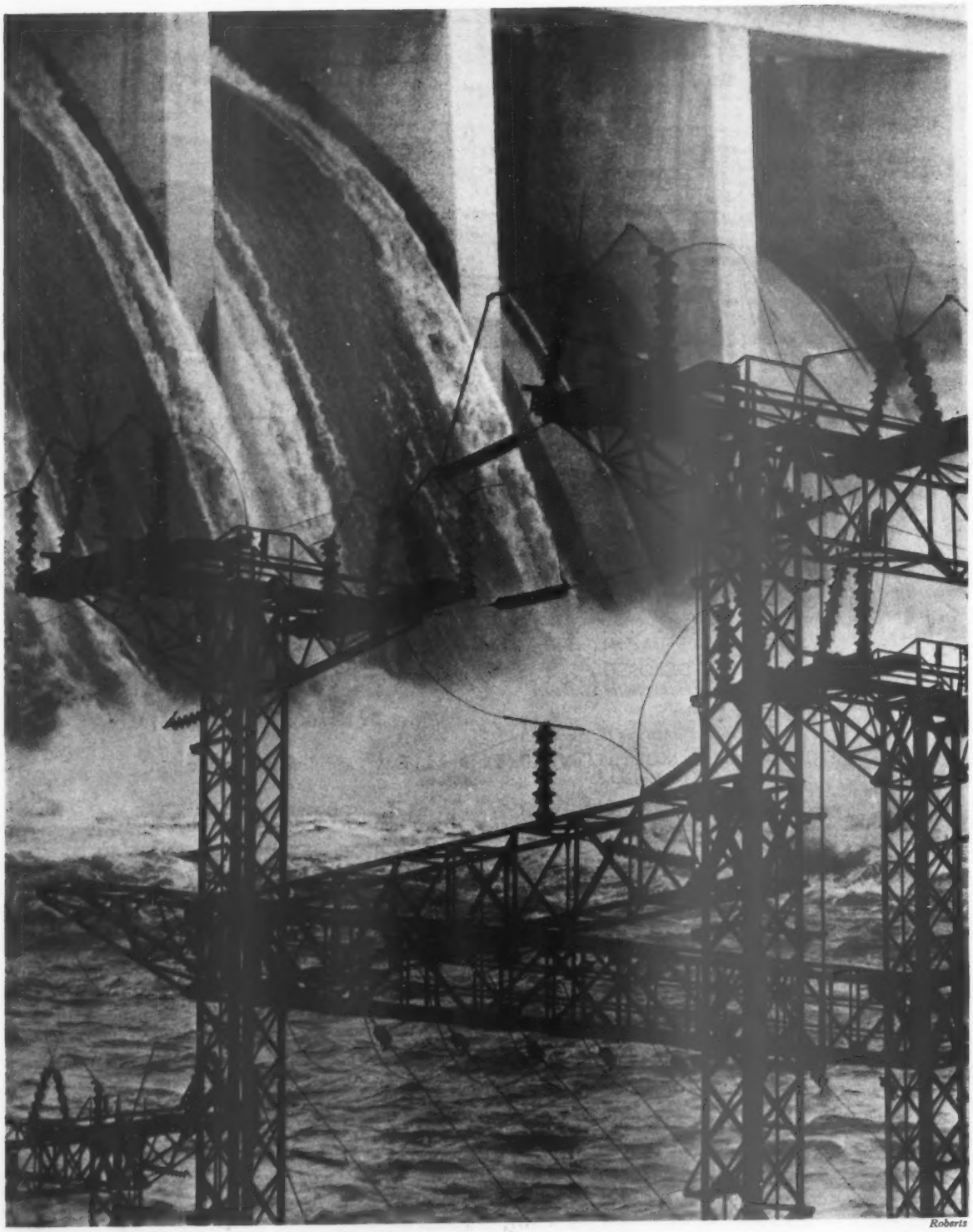


Roberts

POWER

A COMPOSITE PHOTOGRAPH OF THE CONOWINGO HYDROELECTRIC PROJECT

THE TECHNOLOGY
REVIEW

VOLUME 33 MAY, 1931 NUMBER 8

DOODLE-BUGS DEPOSED

Geophysical Prospecting in the Southwest

BY ROLAND F. BEERS

See Page 364

TWO men were riding over a county highway near Seminole, Okla. The car was traveling about 20 miles an hour; the driver was watching his companion very closely. He would bear watching, too, if you could have seen him. His eyes were tightly blindfolded, and between his thumbs he held a forked branch from a peach tree. Bending over the peach branch, he was almost holding his breath, as if he expected something to happen.

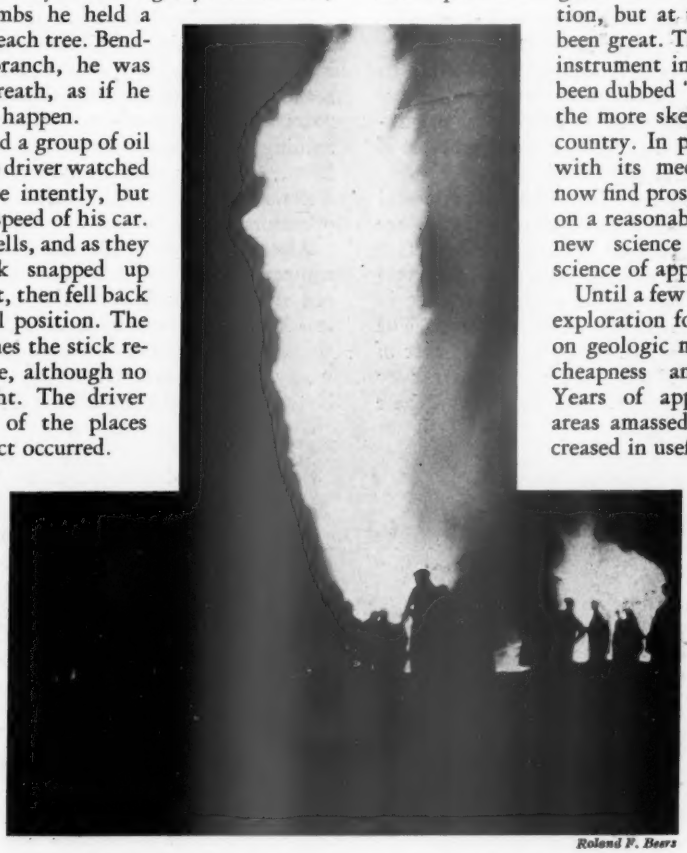
As the car approached a group of oil wells near the road, the driver watched the peach branch more intently, but without changing the speed of his car. Soon they passed the wells, and as they did, the forked stick snapped up against the man's breast, then fell back again into a horizontal position. The car kept on, and at times the stick repeated this performance, although no oil wells were in sight. The driver made a careful note of the places where this curious effect occurred.

The driver of the car represented a small royalty company; his queer-acting companion was a famed "divining rod" operator. Two years ago this "wizard" had stood on a hill in Pottawatomie County and pointed out the site of the present Asher pool. The number of his successes was large; how many failures, no one knows. It is hard to explain a performance like this, but for every case of its kind there are scores of complete failures. "Doodle-bugs," they are called.

Men engaged in the serious business of locating oil for actual production give the doodle-bugs little consideration, but at times their influence has been great. There is not a geophysical instrument in use today that has not been dubbed "doodle-bug" by some of the more skeptical natives of the oil country. In place of the divining rod with its mediæval superstition, we now find prospecting for oil conducted on a reasonable and scientific basis. A new science has been born — the science of applied geophysics.

Until a few years ago, practically all exploration for oil was based entirely on geologic methods because of their cheapness and widespread utility. Years of application in productive areas amassed files of data which increased in usefulness and value as they accumulated in detail. Their success is based on the theory that oil-bearing structures show their presence by similar features on or near the surface of the ground. A map of surface structures thus supplies the lead for further prospecting or drilling.

In the oil-bearing regions of the Southwest, the deposits are found on or near subsurface anticlines or "highs." Buried



Roland F. Beers

"WILD ABE" AFIRE, NEAR WEWOKA, OKLA. THE HUGE GAS WELL CAUGHT FIRE WHEN ATTEMPTS WERE MADE TO "SHOOT IN" THE WELL BY T.N.T. FINALLY EXTINGUISHED BY NITRO-GLYCERINE AFTER HAVING BURNED SEVERAL DAYS

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Helen C. Beers

A RECORDING TRUCK; REFLECTION SEISMOGRAPH. REFLECTION SEISMOGRAPHS EMPLOY MULTIPLE DETECTORS

mountain ranges, ridges, or domes are likely spots for the accumulation of oil. The reasons for this manner of accumulation are frequently technical and detailed, but, in a broad sense, oil migrates to these regions because of its lesser density compared with that of water. The leveling force of gravity, the force of capillary attraction, gas pressure — all these factors combine to force oil to local and regional highs.

The origin of the highs is usually somewhat complicated. Earthquakes, stresses in the earth's crust over long periods of time, isostasy (the tendency of the crust to maintain pressure equilibrium) are some of the factors which cause folds and wrinkles in the originally horizontal strata. Erosion and deposition are secondary causes of the complexity of subsurface structures.

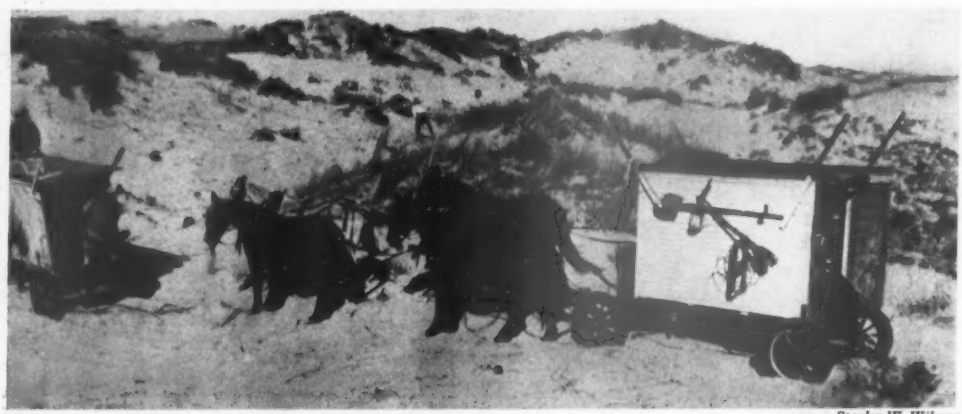
Today, geologic methods are the most generally useful and widespread for reconnaissance exploration. They are particularly good in undeveloped virgin areas. A surface geological party, consisting of a geologist and an instrument man, can map outcroppings at a very low cost in comparison with other methods of exploration. The monthly cost of a good surface party is of the order of several hundred dollars, and such a party can survey about 20,000 acres per month. The success of these methods is shown by the fact that probably 90% of the oil fields lie on surface-shown structures, but very few of such structures are productive. So long as land is cheap and the price of oil warrants the risk of drilling dry holes, these methods are economically satisfactory. The greater part of oil field development has followed along these lines. Until overproduction of oil depressed the industry a few years ago, no great demand existed for improvements in exploration methods.

The development of most oil fields in the Southwest is largely a story of excessive and extravagant well drilling and "wild-catting." Anyone who had the courage and initiative could collect options on a block of acreage in a promising area for a very small cash deposit. These options would be placed in a bank for security and the promoter would then approach oil companies for drilling operations. He would exhibit his surface maps, if there were any, often would produce a doodle-bug expert, and suggest that he was willing to let the company in on his projected well. His price for acreage was generally such that it paid the company to buy a share of his holdings in order to safeguard their own position. If the promoter succeeded in getting enough contributors to his well, he bought up the options and proceeded with the drilling.

Generally he retained enough acreage or royalty to insure him a large profit in case oil was found. If the wild cat proved to be a dry hole, the promoter at least broke even. If too few partners could be found to finance the deal, the options were passed by and the project was abandoned.

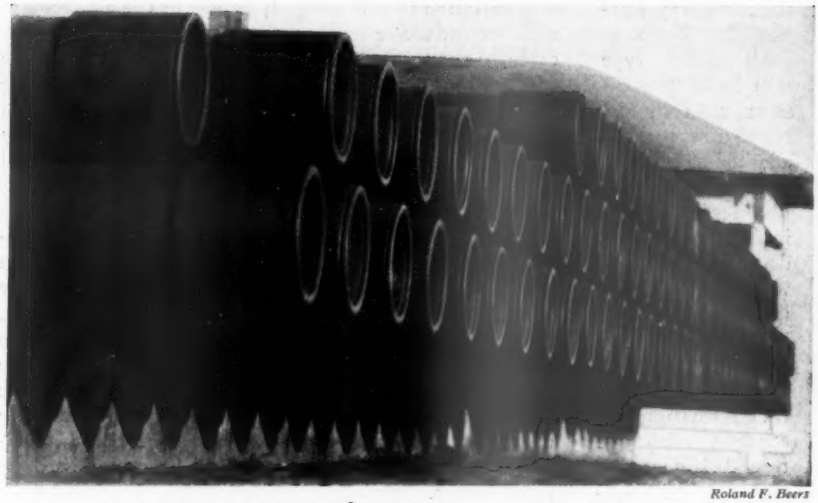
This condition has undoubtedly contributed more to the overproduction of oil than any other single factor. Excessive drilling by large companies has been curbed because of the tremendous fields already opened in recent years and because of improvements in production and refining methods. At present, in one large field in Oklahoma, for every well drilled by major companies, three wells are put down by small scale and irresponsible operators.

After a number of years of this manner of operation, competition for land has become somewhat keener. Virgin areas are gradually being exhausted and prices of leases are climbing rapidly. Today there are unexplored areas where the price of acreage does not warrant drilling, partly because of the prevailing low price of oil, but also because of actual competition for land. For the greater



Stanley W. Wilcox

RECORDING TRUCKS OF A REFRACTION SEISMOGRAPH PARTY ENCOUNTERING FIELD DIFFICULTIES. FROM FOUR TO EIGHT MULES ARE OFTEN REQUIRED TO HAUL THESE LIGHT TRUCKS OVER THE SAND. DUNES FROM 60 TO 100 FEET HIGH ARE COMMON IN THIS AREA — NEAR MONAHANS, TEXAS



Roland F. Beers

A LOADING RACK: PILE OF 8-INCH WELL CASING READY TO BE USED

part, it is no longer possible for the small promoter to exploit a well in the old manner. Even if an operator should succeed in obtaining production in this fashion, he would have difficulty in disposing of his oil, unless he had connections with local refiners and distributors. Most of the large pipe lines are controlled by major companies, which are already overstocked with oil and unable to take the desultory production coming from these unexpected sources. The recent action of the Prairie Pipe Line Company in cutting off its small feeders in Oklahoma and Kansas illustrates the tendencies confronting the small producer today.

WITH a gradual transfer of control in the industry to the hands of the larger companies, there arises a demand for improvement in all operations. It is imperative that the industry maintain its methods of operation on scientific and economic bases. We have already seen the power of scientific procedure in refining methods. The cracking process increased gasoline production from 20% to 40%. The Bergius hydrogenation process further increased the yield to 98%. The unit plan of oil field development is a scientific method of obtaining maximum yield from a new oil pool. Similar details of refinement are in progress throughout most of the major producing companies. By such revisions as these the industry is gradually climbing to a position of economic security. It is not unnatural, therefore, that scientific methods of oil location should meet with the wide acceptance of petroleum executives, even in a time of unwonted depression.

By means of reliable geophysical methods, leasing activities can be confined to areas showing good possibilities of production. Old leases can be explored, and, if found to be non-productive, they can be turned loose. The annual rental of a dollar an acre will pay for many months of geophysical work by a major company. Old oil pools can be surveyed by geophysical means which will determine their edge and reduce the number of dry holes that are being drilled in these pools. New areas will be explored; pools will be located and allowed to remain undrilled until economic demand warrants their production. In cases where several companies have holdings in a geophysically located field, information may be exchanged, a community pool formed, and scientific methods of production may be employed. At present, whenever one well brings in production, all lease holders offsetting it must also drill, by terms of the lease contract, unless the community plan is in effect. By geophysical means, reserves for the distant future may be acquired and if no drilling in their vicinity jeopardizes their security, the oil may be left stored in the ground at the cheapest storage the world provides.

One additional feature has contributed greatly to the growth of applied geophysics. There are certain areas in oil-producing regions where no geologic data are available. In these areas development by wild-catting is gradually giving way to the use of geophysics. The great Permian basin of West Texas, western Oklahoma and Kansas, is a good example of this type of exploration. The alluvial plains of northern Venezuela offer similar possibilities. Already parts of West Texas have been

Ben S. Melton

TAKING FIELD MEASUREMENTS IN THE ELECTROMAGNETIC METHOD OF OIL PROSPECTING. THE OBSERVER IS IN COMMUNICATION WITH THE SENDING STATION BY RADIO. THE TWO HELPERS ARE HOLDING THE RADIO ANTENNA ABOVE THE GROUND DURING THE PERIOD OF COMMUNICATION. THE INDUCTIVE LOOP MOUNTED ON THE TRIPOD IS USED TO MEASURE HORIZONTAL AND VERTICAL COMPONENTS OF THE ELECTROMAGNETIC FIELD, AS WELL AS THE PHASE ANGLE. A VACUUM TUBE AMPLIFIER AND IMPEDANCE BRIDGE ARE SHOWN IN THE PICTURE

Helen C. Beers

T.N.T. SHOT TAKEN JUST AFTER THE FIRE OF THE CHARGE

successfully surveyed and other fields of this type will be covered as soon as technical methods can be adapted to them.

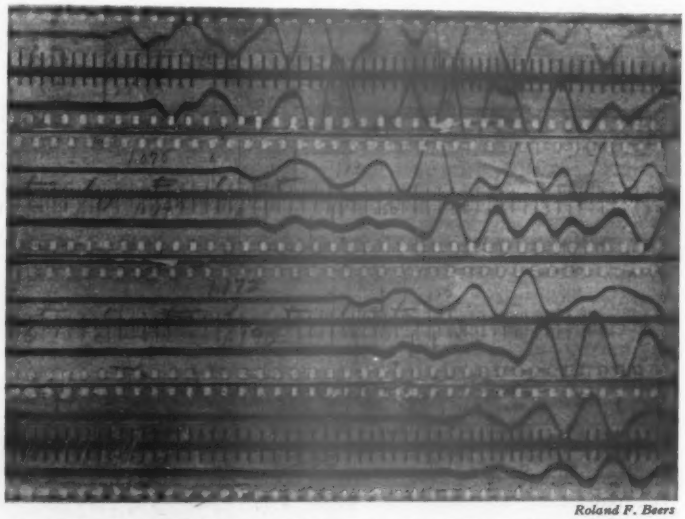
Of all the geophysical methods in common use today, there are four which have some importance. Each one is based on some property of the subsurface rock formations, in contrast with the over-lying rocks. None of the methods measure any common quantity, hence correlation of surveys by different methods is often difficult. The four principal systems are called the electric, magnetometric, gravimetric, and seismic. None of the methods operate on the properties of oil, with the possible exception of the electric method. They are usually concerned with some rock formation more or less closely associated with oil-bearing strata. The determination of a satisfactory structure is not the sole criterion for the location of oil. Geophysical surveys are generally interpreted by the coöperation of a geologist and a geophysicist, who are able to determine whether the other essential conditions are present, such as porosity, opportunity for accumulation, and presence of oil-producing agencies.

The electric method is based upon the relative conductivities of those horizons conformable with production and of the other layers in the geologic section. There are in general two methods of field procedure. The electric method is accomplished by establishing an electric field between two surface earth electrodes a mile or more apart, and making potential measurements of this field at close intervals. If the earth materials are everywhere uniform in composition and occurrence, no anomalies of potential distribution are found. Layers of conducting material, such as salt water bearing sediments, are employed as key horizons, upon which indications of geologic structure may be observed. By mapping the equipotential lines found at the surface, changes in subsurface formations are determined. Either alternating or direct current may be used; but direct current offers the only possibility of penetrating below highly conducting layers.

A variation of this method, known as the electromagnetic or inductive method, employs a loop of electric cable on the surface carrying an alternating current. The field of this current induces a secondary field in the ground layers. By measurement of the horizontal and vertical components of the superimposed fields, as well as the phase angle, indications of conducting layers and their positions are determined. Because of the complicated mathematical theory required for the rigorous interpretation of field measurements, the number of successful applications of the electric methods has not been great. Their use has been largely confined to shallow structures and to abrupt changes in subsurface formations, such as faults and shallow salt domes. At present the usefulness of the instruments lies in a maximum range from 1,000 to 2,500 feet. The methods offer considerable attractiveness because of the possibility of ultimately extending their use to measurements on oil bodies themselves. Here their usefulness would be unsurpassed by other means.

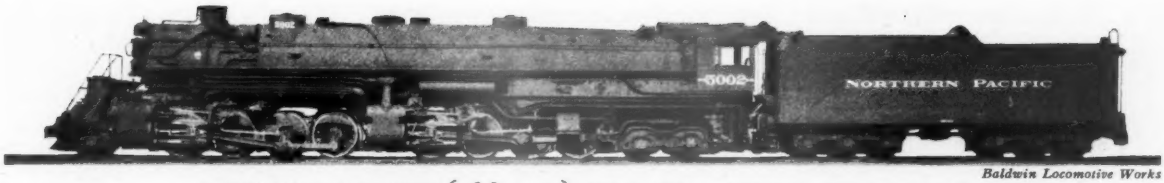
The magnetometric method functions by virtue of the differences in magnetic susceptibility of rocks. The earth's magnetic field is assumed to be regionally constant at any given time. Anomalies are caused by the occurrence of local magnetic materials. There are many forms of the magnetometer, ranging in style from the dipping needle to the more recent Super-Dip by Hotchkiss and the micro-magnetometer by Rieber. Variations in the magnetic field by the action of sedimentary rocks are extremely small. The accuracy of their measurement is limited by the great masking effect of the general field of the earth. In practice, it is customary to neutralize the general field of the earth, leaving the anomalies exposed for observation.

(Continued on page 406)



Roland F. Beers

A REFRACTION SEISMOGRAPH RECORD. IN REFRACTION WORK, THE "FIRST BREAK," OR EARLIEST ARRIVAL OF WAVES FROM THE EXPLOSION, IS THE BASIS OF THE PROCEDURE. THESE "BREAKS" CAN BE SEEN INDICATED BY PENCILED ARROWS ON THE ORIGINAL RECORDS. FROM THE TIME OF THESE POINTS, THE DEPTH OF THE REFRACTING HORIZONS CAN BE COMPUTED. VELOCITY OF THE OVERLYING BEDS ARE DETERMINED BY SHOOTING ACROSS A WELL, WHOSE DATUM VALUES ARE WELL ESTABLISHED. THE WAVES ARRIVING AFTER THE FIRST BREAK ARE TOO COMPLICATED TO INTERPRET WITH RELIABILITY, BUT OFTEN SERVE AS GUIDES IN ESTABLISHING THE FIRST BREAK. THE TIME BETWEEN THE SHORT VERTICAL LINES IS .01 SECONDS



Baldwin Locomotive Works

BALDWIN SINGLE EXPANSION (2-8-8-4 TYPE) ARTICULATED LOCOMOTIVE. BUILT APRIL, 1930

STEAMING UP

Steam's Bid for Posterity on the Rails

By Harold E. Lobdell

See page 364

THROUGHOUT American railroading's first hundred years, steam has remained the dominant form of motive power. The story began in August, 1829, when the *Stourbridge Lion*, brought from England by the Delaware and Hudson Canal Company, made a successful 17-mile trip on wooden rails. It continued throughout the nascent 1840's when the Harlem Railroad was complimented in the public prints for introducing cars "so high that one can stand erect when he cannot find a seat;" the pioneering 1850's and 1860's which saw the continent spanned, the advent of Pullman sleepers, primitive diners and Sir Henry Bessemer's means for making steel rails a practicability; and the 1870's with their extended use of air brakes. During all this time and the expansion period of the burgeoning decade of the 1880's in which nearly 70,000 miles of new tracks were laid down, steam's commanding position remained unchallenged.

Midsummer of 1895 brought the initial threat of competition. In June of that year, the Nantasket Branch of the New York, New Haven and Hartford, hitherto a steam road, began electrical operation; in August, steam was banished from the Baltimore tunnels of the B. & O. With the turn of the century, a bad accident in the Park Avenue tunnels of the New York Central, to the seriousness of which low visibility due to steam and gases contributed, focused public interest on the manifest benefits of abating smoke, fumes, noise and fire hazard from tunnels and terminals.

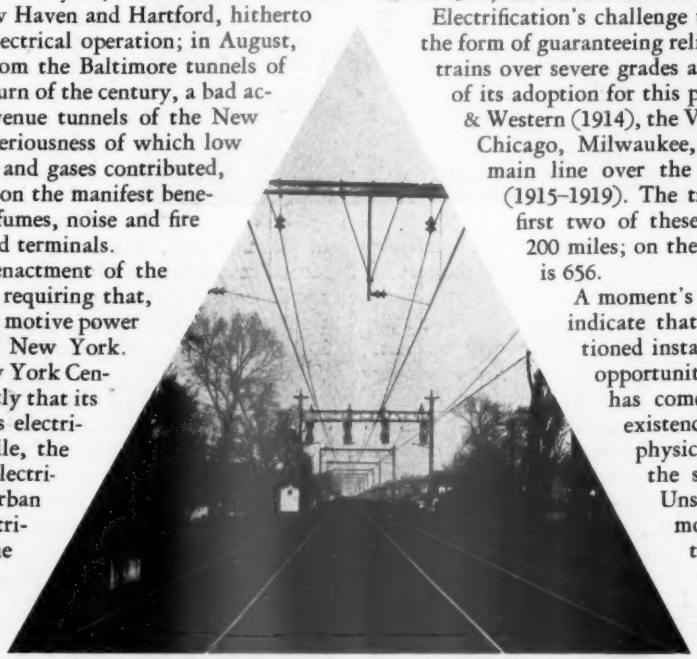
There followed an enactment of the New York Legislature requiring that, after July, 1908, electric motive power be used in the City of New York. With this edict the New York Central complied so promptly that its entry into the city was electrified by 1906. Meanwhile, the Long Island Railroad electrified much of its suburban service. Subsequent electrifications in and about the New York area, with the approximate dates of their completion include: the New Haven to Stamford, 1907, and to New Haven, 1914; the entry of the Pennsylvania to Manhattan, 1910; the connecting railroad over the Hell Gate Bridge, 1918; and, most recently, the Lackawanna's suburban service, 1930.

Steam's ultimate passing from congested urban areas now seems assured. Urban electrification improves the values of adjacent property and permits the use of "air rights" over trackage for hotels, office buildings and other structures. Philadelphia in 1915–1918, Chicago in 1926 as far as the entry of the Illinois Central is concerned, and Cleveland in 1930, began to benefit from these obvious results of the partial or complete exile of steam.

In tunnels, other than those connected with terminal developments, electrification has again been resorted to with advantage in such instances as the St. Clair between Port Huron, Mich., and Sarnia, Ont., in 1908; the older Cascade of the Great Northern in 1909 and the later tunnel of like name in 1929; the Detroit of the Michigan Central in 1910; the Hoosac of the Boston & Maine in 1911.

Electrification's challenge to steam has also taken the form of guaranteeing reliable operation of heavy trains over severe grades and three chief examples of its adoption for this purpose are: the Norfolk & Western (1914), the Virginian (1926), and the Chicago, Milwaukee, St. Paul and Pacific's main line over the Rockies and Cascades (1915–1919). The trackage on each of the first two of these projects approximates 200 miles; on the last, the route mileage is 656.

A moment's reflection will suffice to indicate that in all the above-mentioned installations electrification's opportunity for contest with steam has come as the result of the existence of "bottlenecks," or physical obstacles impeding the smooth flow of traffic. Unscrambling tangled train movements by increasing the capacity of trackage, quickly, efficiently, and minus an accompaniment of din and dirt, has been electrification's forte.



A SECTION OF THE D. L. & W. R. R. SUBURBAN ELECTRIFICATION

Roberts

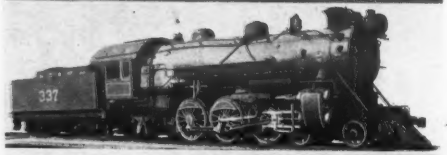
If, however, it is ever to displace steam as the dominant form of railroad motive power, it must meet the test of main-line usage. Here the competition must be on a basis of economics, unadulterated by the special advantages which weigh heavily in terminal zones or in tunnels. Though prompted by gradients on its right-of-way over the mountains, and influenced by the scarcity of near-by coal and the presence of plentiful near-by water power, the St. Paul's electrification must be treated as the pioneer example of main-line electrification over a considerable distance. The well-known economic history of this road, though it may not be entirely chargeable against electrification, can hardly be construed as an argument in its favor.

Under certain special conditions, however, where dense and heavy main-line traffic conditions prevail; where increased capacity is vital and the laying of additional trackage is impossible or impractical; where operating economies are obtainable through large daily locomotive mileages — in other words, where main-line traffic conditions approach a "super-bottleneck" situation — electrification temptingly beckons to harassed operating executives. Such a situation has impelled the present undertaking of the Pennsylvania to electrify between New York and Washington, and on the outcome of this venture, electrification's destiny for main-line usage in the future will be in a large measure predicated.

As Professor Dugald C. Jackson succinctly pointed out in The Review over a year ago, "the shortcoming of railroad electrification is the first cost, which is high compared with steam motive power for most situations; and this limits the economic applicability of railroad electrification in America. . . ." When it is considered that the capital expenditure to electrify a steam road is commonly of the order of $35,000 to $75,000 per track-mile (excluding motive power and rolling stock) depending upon the location and character of service, and that the initial outlay for an electric locomotive may run twice that for a modern steam engine, the truth of his observation is apparent. Except under very special conditions, the operating economies which electrification must effect to counterbalance heavy carrying charges on its installation, are impossible of attainment.

Thus it is a fact that, with all of electrification's quarter century of development, the commencement of railroading's second century still finds 99% of the country's route mileage dependent upon steam for motive power. In 1920 the electrified route mileage in the United States was about 1,450, by 1929 it had passed 1,850, and it will soon approximate 2,300. But at this rate of growth, even if it be maintained, many years must elapse before any very large proportion of the quarter million miles of the country's railroads will have adopted electric operation.

For years American railroads have been accustomed to buy their steam motive power units at less first cost than other power could be provided and, even as this is detrimental to the case for the electric locomotive, so may it be expected to inhibit the adoption of oil-burning internal combustion locomotives, the cost of which exceeds that of the electric. Much evidence pointing to savings in the operating and maintenance expense must be adduced to mitigate the effect of this higher first cost.



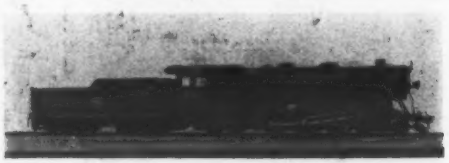
TEN WAYS OF EXPRESSING THE DEVELOPMENT OF THE LOCOMOTIVE BETWEEN 1905 AND 1931*

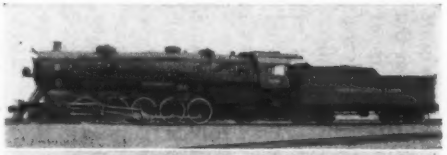
	1905	*1910–13*	*1918*	*1923–25*	*1931*
1. Axle Loads (lbs. per pair of wheels)	40–45,000	50,000	55–60,000	63,000	65–72,000
2. Steam Pressure (lbs. per sq. in.)	180–200	200	200–210	210–225	250–275
3. Steam Quality (temperature degrees F.)	385 saturated	538 (sup. 150)	590 (sup. 200)	650 (sup. 250)	700 (sup. 300)
4. Stoker	none	only large articulated engines	heavy road engines	heavy road engines	heavy road engines
5. Feed Water Heater	none	none	experimental	about 50% application	all road
6. Combustion Rates (lbs. of coal per hr. per sq. ft. of grate area)	100–150	80–120	80–120	80–120	100 or less
7. Tender Capacity (gallons)	6–8,000	8–9,000	10,000	15,000	18–22,000
8. Steam Consumption (lbs. per I. H. P. per hr.)	28	21	20.5	19–20	18.5
9. Typical Tractive Power (lbs.)	40,000	50,000	60,000 (2-8-2) 75,000 (2-10-2)	63,000 (2-8-2) 82,000 (2-10-2)	70,000
10. No. of parts in Locomotive Bed	250 total, of which 35 were major parts				1

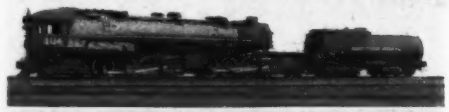
* *After data compiled by C. F. Krauss, Baldwin Locomotive Works*

ILLUSTRATIONS

IN THE LEFT COLUMN READING FROM TOP TO BOTTOM: THE FIRST THREE LOCOMOTIVES WERE BUILT IN 1905. THE FOURTH, FIFTH, AND SIXTH IN THAT COLUMN ARE LOCOMOTIVES BUILT FROM 1910 TO 1913. THE LAST TWO LOCOMOTIVES IN THE LEFT COLUMN, THE ONE IN THE TOP CENTER, AND THE FIRST TWO IN THE RIGHT COLUMN ARE LOCOMOTIVES BUILT IN 1918. THE THIRD, FOURTH, AND FIFTH IN THE RIGHT COLUMN WERE BUILT FROM 1923 TO 1925. THE REMAINING THREE IN THE RIGHT COLUMN AND THE ONE PICTURED BELOW WERE ALL BUILT IN 1930







Although a Diesel locomotive was built in Switzerland in 1911, the first American-built Diesel was not produced until 1924, and up to now, there are less than 125 in use in this country. Most of these are of low power, around 300 to 400 horsepower (900 is the largest), and their employment has been confined to industrial and light transfer service.

None in the United States has been developed for main-line usage. The experimental two-unit Diesel, each unit having 1,330 horsepower, built by the Canadian National, is the largest on record. There seems to be no impending solution to the problem of building a Diesel locomotive of 4,000 to 5,000 horsepower, which would be comparable with the rating expected for present-day, main-line service. It cannot be denied, however, that the Diesel with its promise of lowered operating costs is to be reckoned with in an inventory of American railroad's future motive power facilities.

Like the electric, the Diesel is a potential threat to the realm of steam, but it seems quite likely that steam will maintain its prestige for many years to come in so far as the bulk of the country's rails are concerned. One very important fact supporting such a conclusion is furnished by the transformation of the steam locomotive's design since the time of the accident in the Park Avenue tunnels nearly 30 years ago.

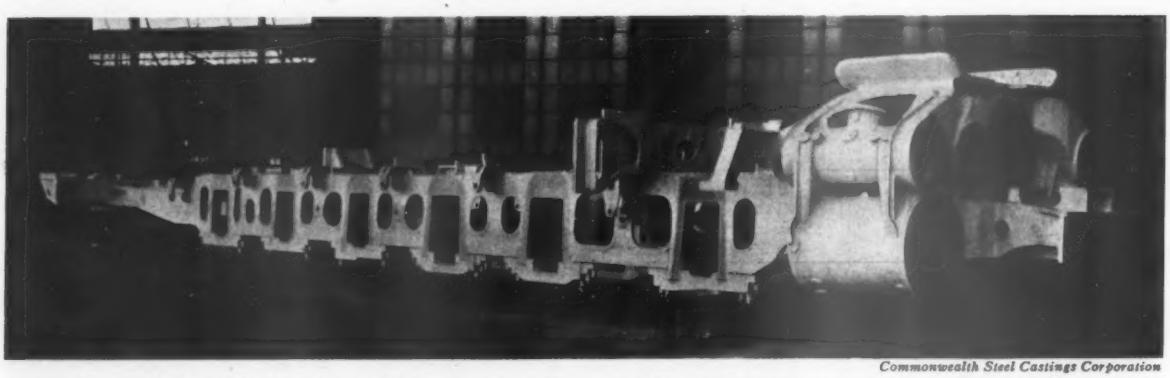
Except for size and the number of driving wheels, the standard steam locomotive of that time differed little from the typical one of the Civil War period. The Stephenson Link Motion was about its only economy device. Three American (4-4-0) locomotives delivered to the Central of New Jersey in 1906 weighed 158,000 pounds with a weight per driving wheel of 27,000 pounds; otherwise, they resembled the heaviest locomotive of 1881, an American on the Reading, which had a total weight of 96,200 pounds with 16,000 pounds per driver.

The point had come, nevertheless, when locomotive designers recognized that demands for increased power could not for long continue to be met merely by building larger locomotives. Hitherto, the limits of height and width had been ample for expansion and heavier rails could be laid to cope with the extra weight. Fuel was comparatively cheap and the size of locomotives too great to be fired by hand had not yet been attained. To be sure, the compound engine had been used to reduce the fireman's task by saving fuel, and in 1904 the first articulated compound in the United States had been built from the designs of J. E. Muhlfeld. The principle of the articulated locomotive, which was the invention of Anatole Mallet by whose name it is commonly known, divided the locomotive frame into parts connected by a hinged joint and doubled the permissible number of driving wheels. The resulting great tractive effort proved a boon in handling heavy trains on heavy grade lines, especially where speed was not of prime importance.

Shortly after the close of the period 1905–1910 found the superheater in general use, the wide firebox and brick arch, the Walschaert outside valve gear. The first of these was beyond question the greatest forward step in locomotive engineering since the invention of the locomotive itself. With the superheater it was possible to realize in the simple engine economies equal to or better than those of the saturated compound. Year by year after 1910, stokers came more into general use on larger engines, the feedwater heater had chances for trial experimentally, and general practice called for the substitution of cast steel for cast iron in the chassis.

With the close of the Great War economy and speed became of major interest to the railroads. Costs of fuel and other materials had risen as well as wages, the return of their property from government operation found many of the carriers financially embarrassed. Besides the public demanded faster freight movements, and "gross ton-miles" was superseded as the yardstick for measuring railroad freight capacity by "gross ton-miles per engine hour." In the West particularly, speed loomed as the only way to offset the cheapness of water shipment via Panama. Thus came locomotives with higher steam pressures, with capacities entirely beyond the possibilities of handfiring, with 1,100 horsepower output per driving axle instead of the 500 to 600 which denoted a good machine of the immediate pre-War years, with feedwater heaters as standard equipment, with a one-piece cast steel bed replacing 250 parts of the older engines, with tenders thrice the size they were in 1905. The table and illustrations on the preceeding page present the highlights of the last quarter century of the steam locomotive's family tree.

To exemplify the recent improvement in steam locomotive design, a writer in a recent number of a popular magazine says, "Whereas in 1922 the steam engine required 163 pounds of coal to move 1,000 tons one mile, by 1929 it required only 125 pounds, (*Continued on page 420*)



Commonwealth Steel Castings Corporation

ONE PIECE CAST STEEL LOCOMOTIVE BED. UNTIL RECENTLY A LOCOMOTIVE BED WAS MADE UP OF 250 SEPARATE PARTS

THE PILL OF IMMORTALITY

A Translation from the Chinese of the Earliest Known Treatise on Alchemy Reveals Some Second-Century Miracles

By Tenney L. Davis and Lu-Chiang Wu

See page 364

LATER Chinese alchemists refer to Wei Po-yang as the "Father of Alchemy" and regard his *Ts'an T'ung Ch'i* (Akinness of the Trio) as the earliest treatise in the Chinese language which is devoted exclusively to the subject of alchemy. Although it was written in the first half of the second century, about 142 A.D., it is by no means the earliest Chinese writing which makes mention of alchemy. It shows that an extended and definite alchemical tradition already existed, and makes mention of several earlier alchemists concerning whom other information is available either from their own writings or from the historical books.

For three or four centuries before Wei Po-yang, the Chinese had been engaged in an effort to transmute base metals into gold — not because gold was intrinsically valuable, but because the magical efficacy of artificial gold was such that the eating of food out of vessels made from it would produce longevity — and they were attempting to prepare the elixir of immortality from cinnabar. The similarity of the methods and aims of the Chinese alchemists with those of the later Greek, Arab, and Latin Europeans suggests that all alchemy derives from a single origin. While it is possible that the appearance of alchemy in China in the second or third century B.C. resulted from the influx of alchemistic teaching from Egypt or from Mesopotamia, we have no early alchemical documents from the latter places — and the *Ts'an T'ung Ch'i* of Wei Po-yang appears to be the earliest treatise entirely on alchemy with which we are at present acquainted.

Chinese alchemy, like all of Chinese science, is erected upon the fundamental concepts of *Wu-hsing* (the Five Elements) and *Yin-Yang* (the Contraries). These are genuine scientific concepts which supply categories for the description of natural things.

The notion of *Wu-hsing* (the Quintet; water, fire, wood, gold or metal, and earth) as a scientific concept remounts to the twelfth century B.C. Since about the third century B.C. it has carried a magical connotation as well, the Five Elements being associated with the five seasons, the five locations, the five colors, the five tones, the five tastes, the five animated species, the five internal organs, the five ways of righteous conduct, the five social relationships, the five grains, the five domesticated animals, and so on.

Although the idea of the Contraries, by the interaction of which all things in the universe are produced or created, was developed as a philosophic dualism by Confucius in the sixth century B.C., the doctrine of *Yin-Yang* in which the Contraries possess both a scientific and a magical connotation did not appear in Chinese thought until about the time that Wu-hsing took on its magical relationships, until about the time that alchemy commenced to flourish. The circumstances create a strong presumption that the idea-system which includes alchemy and magic and *Yin-Yang* was introduced into China from some other civilization.

Yin was the female principle, undesirable, heavy, gross, passive, cold, and dark. *Yang* was the male principle, desirable, light, active, hot, and fiery. Together they were the *Liang I*, or the two regulating powers, and constituted the soul of the universe. Wei Po-yang in the *Ts'an T'ung Ch'i* positively identifies *Yang* and *Yin* with the Sun and Moon respectively. The Sun and the Moon, we know, were the two prime powers in the religions of Babylonia and Egypt. We find in Chinese alchemy a parallel of the teaching of Hermes Trismegistos who says in the Emerald Table that "the father of it is the Sun, the mother of it is the Moon."

WEI PO-YANG WITH HIS DOG AND HIS DISCIPLE, ALL OF WHOM, ACCORDING TO THE STORY, ATTAINED IMMORTALITY BY CHEMICAL MEANS

The Chinese alchemists were Taoists and their writings have been preserved as a portion of the canon of the Taoist religion. The texts which have come down to us are probably authentic. A number of scholars have believed that alchemy was indigenous to China, a natural and spontaneous outgrowth from the magical and fantastic side of the Taoist religion, and have adduced good reasons for the opinion. Their argument loses much of its strength when we consider that the pure mysticism of Lao Tzŭ, the pursuit of the *Tao* or Way, after remaining a more or less abstract philosophic doctrine for

FROM A TWELFTH CENTURY CHINESE TEXT ON ALCHEMY. NOTE THE FURNACE RESEMBLING THE KEROTAKIS OF THE ALEXANDRIAN ALCHEMISTS

about three centuries, underwent a sudden expansion into a great religion and, in expanding, took on magic and superstitious practices, Yin-Yang, and alchemy. At any rate, it is established that the doctrine of the Tao provided a fertile medium for the growth of alchemy.

Wei Po-yang was a Taoist philosopher and alchemist, a native of Wu in the present province of Kiangsu. In the year 121 A.D. he was summoned to Court but refused the invitation because he had no liking for officialdom. In the Epilogue of the *Ts'an T'ung Ch'i* he describes himself as "a lowly man from the country of Kuei, who has no love for worldly power, glory, fame, or gains, who wastes his days leading a simple, quiet, leisurely, and peaceful life in a retreat in an unfrequented valley."

THE *Ts'an T'ung Ch'i* is one of the Taoist Classics and purports to be a commentary on the Book of Change but is really a treatise on the preparation of the pill of immortality. The *Lieh Hsien Chuan Tsuan* (Complete Biographies of the Immortals) says that Wei Po-yang "entered the mountains to make efficacious medicine. With him were three disciples, two of whom he thought were lacking in complete faith. When the medicine was made, he tested them. He said, 'The gold medicine is made but it ought first to be tested on the dog. If no harm comes to the dog, we may then take it ourselves; but if the dog dies of it, we ought not to take it.' (Now Po-yang had brought a white dog along with him to the mountains. If the number of the treatments of the medicine had not been sufficient or if harmonious compounding had not reached the required standard, it would contain a little poison and would cause temporary death.) Po-yang fed the medicine to the dog, and the dog died an instantaneous death. Whereupon he said, 'The medicine is not yet done. The dog has died of it. Doesn't this show that the divine light has not been attained? If we take it ourselves, I am afraid we shall go the same way as the dog. What is to be done?' The disciples asked, 'Would you take it yourself, Sir?' To this Po-yang replied, 'I have abandoned the worldly route and forsaken my home to come here. I should be ashamed to return if I could not attain the hsien (immortal). So, to live without taking the medicine would be just the same as to die of the medicine. I must take it.' With these final words he put the medicine into his mouth and died instantly.

DRAWING OF A STILL FROM A THIRTEENTH CENTURY CHINESE TEXT

On seeing this, one of the disciples said, 'Our teacher was no common person. He took the medicine and died of it. He must have done that with especial intention.' The disciple also took the medicine and died. Then the other two disciples said to one another, 'The purpose of making medicine is to attempt at attaining longevity. Now the taking of this medicine has caused deaths. It would be better not to take the medicine and so be able to live a few decades longer.' They left the mountain together without taking the medicine, intending to get burial supplies for their teacher and their fellow disciple. After the departure of the two disciples, Po-yang revived. He placed some of the well-concocted medicine in the mouth of the disciple and in the mouth of the dog. In a few moments they both revived. He took the disciple, whose name was Yü, and the dog, and went the way of the immortals. By a wood-cutter whom they met he sent a letter of thanks to the two disciples. The two disciples were filled with regrets when they read the letter."

In many respects the *Ts'an T'ung Ch'i* bears a strong resemblance to the later alchemical treatises of the Europeans. The author mentions the obscurity of earlier writers and states that he is making an effort to be clear in spite of his feeling of inferiority and inadequacy for the task. His description of the processes is about as lucid, or about as obscure, as the descriptions of the mediaeval alchemists. He gives symbolic and imaginative names to many of the substances which are used, and insists upon the necessity for careful and accurate compounding and for a cautious interpretation of the text which, he says, he has intentionally obscured in places. He has a keen sense of humor and a proper appreciation of the value of grotesque illustrations in an argument. He gives really poetic descriptions of the effects of the pill of immortality.

The following passages are quoted from a complete translation, by one of the authors of this article (Wu), of the *Ts'an T'ung Ch'i* which is now being edited for publication.

"Descriptions of processes are many and varied, numbering upward of ten thousand. Most of them violate the doctrines laid down by Huang Ti and Lao Chün, and being awkward are also out of accord with Chiu Tu.

"Wise men, understanding this principle, know clearly what course to follow. They practice with diligence day and night. Having eaten the medicine for three years, a man attains buoyancy of movement and is able to travel great distances. Stepping over a fire, he is not scorched; dipped into water he does not get wet. He is

able to appear and to disappear at will. He will be happy forever. Having attained the *Tao* (Way) and the *Tê* (Magnanimity-virtue), he hides himself to await his time. In time, *Tai I* (the Supreme One) will give the order for him to remove his residence to Chung Chow (Central Isle). Thence, upon fulfilment of the required deeds, he will be raised on high and duly ordained.

"In order that the Treatise on Fire shall not have been in vain, I shall explain here in simple language. Like the moon lying on its back is the shape of the furnace and the pot. In it is heated the *Pai Hu* (White Tiger). *Kung Jih* (Mercury Sun) is the flowing pearl and with it is *Ch'ing Lung* (Blue Dragon). . . .

"When gold is placed in a hot fire, it is not deprived of the brilliancy of its color. Since the days of the unfolding of the universe (Creation), the sun and the moon have not diminished in brightness nor has gold lost any weight. The shapes of the sun and of the moon have always been the same. Gold is born under the influence of the moon. At daybreak, receiving magic force from the sun, it returns to its mother. Being enveloped by the sun at the wane of the moon, it hides within the walls and abandons itself to inanity. Thus does the gold regain its original nature. Only when intense brightness is obtained is the *Ting* (furnace-pot) well heated. . . .

"Yellow earth is the father of gold and flowing pearl the mother of water. Earth is the *Kwei* (ghost) of water, and it is not able to arise because of the over-bearing of the earth. The *Chu-ch'ueh* (Red Bird) is the spirit of fire and dispenses victory or defeat with justice. With the ascendance of water comes the vanquishing of fire. Dying together they return to Mother Earth. The three natures merge together and thus show their common origin.

"Longevity is of primary importance in the great triumph. *Huan Tan* (Returned Medicine) is edible. Gold is non-corruptible in its nature and is therefore the most valuable of things. The *Shu Shih* (Men of the Art, Magicians) feeding on it attain longevity. Earth, traveling in all seasons, delineates the boundaries and formulates rules to be observed. The *Chin Sa* (Gold Dust), having entered the five internal organs, spreads foggily like wind-driven rain. Vaporizing and permeating it reaches the four limbs. Thereupon the complexion becomes rejuvenated, hoary hair regains its blackness, and new teeth grow where fallen ones used to be. If an old man, he will once more become a youth; if an old woman, she will regain her maidenhood. Such transformations make one immune from worldly miseries, and one who is so transformed is called by the name of *Tsun Jen* (True Man).

"*Hu* powder, on being placed in the fire, becomes discolored and changes back into lead. On treatment with hot liquids, ice and snow dissolve into *T'ai Hsuen* (the Extremely Intangible). Gold is chiefly made up of sand and derives other properties from mercury. The transformations concern only the essence of the materials. Causes and effects are traceable in the course of the changes. The way to make oneself a *Fu Shih Hsien* (a Drug-using Supernatural Being) lies in the use of drugs of a nature similar to oneself. For rice seeds are used in the raising of rice, and chicken are hatched from hen's eggs. Things found in nature, when given proper help according to their kind, will result in things easy to improve. Fish eyes cannot replace pearls, and tall weeds cannot be used for timber. Things of similar nature go together: queer things cannot be realized. This explains why the swallow does not give birth to peacocks, and the fox and the rabbit do not mother horses. This explains also why flowing water does not heat up what is above it, and why moving fire does not wet what is under it.

DRAWING OF A STILL FROM A TWELFTH CENTURY CHINESE TEXT

"Many are the learned scholars, but they are too profound to be understood and are therefore lost to the world. They never meet with good fortune: their belongings are devoured by devastating fire. They follow the printed word and sometimes they follow their blind inclinations. The start they make is improper and subsequent regulation is wanting. *Chiang Shih Tan* (a kind of stone), *Yün Mu* ("cloud mother" or mica), and alum are crushed together and cured. Sulfur is burned with elm wood. Mud and mercury are treated in a mixture. These form the support and pivot of the five stone coppers under the drum. Things of different nature and kind are unwilling to unite and live together. Ten thousand failures will come from a thousand attempts. Doubts will fill the heart in middle age. The right course has been abandoned to follow the mistaken path, and the view is too narrow for proper judgment of the future. . . .

"The Treatise on Fire comprises six hundred chapters which treat of the same subject. They are so cautiously worded that they are not easily understood by people of the world. When things are traced back to their origin, it will be found that the bright and the dark (the obvious and the obscure) are in close union. A profound subject like this is fit to be treated only by the wise. It is presumptuous therefore for me to write on it. But I cannot hold my peace either; for it would be a

(*Cont. on page 418*)

DRAWING OF A MORTAR FROM A TWELFTH CENTURY CHINESE TEXT

BABBLE IN THE AIR

Are the Public and the Newspapers Ready to Rebel Against Indiscriminate Broadcasting?

By Robert E. Rogers

See page 388

Bradley

A MODEL OF THE PROJECTED ROCKEFELLER OR RADIO CITY IN NEW YORK — TERMED BY LEWIS MUMFORD "THE SORRIEST FAILURE OF IMAGINATION AND INTELLIGENCE IN MODERN AMERICAN ARCHITECTURE"

IS THE American radio owner (nearly 15 million of him according to latest figures) getting discontented with his evening's entertainment? One might think so. Only this past week, while I have been mulling over this article, with one ear more than usually cocked toward the loud speaker, I have detected an undoubtedly apologetic note in some of the advertising announcements, a note which certainly didn't use to exist. One speaker said quite frankly that the program existed for its advertising value and that the sponsors (a two-dollar word) hoped to make the advertising as interesting as the program. They didn't. Another, advertising a cigar, read a long paragraph, which said incidentally some nice things about the cigar while explaining that he was going to use only 20 words to advertise the cigar. Count 'em — 20! A third announced that his program was to be "a salute to advertising" in gratitude for its services to radio. Remembering William Orton's assault in the January *Altantic Monthly* called "The Level of Thirteen Year Olds" and his more technical but still forthright sequel in April, "Unscrambling the Ether," one is inclined to believe that straws show which way the wind blows, that chickens come home to roost, that vinegar never catches flies, and other homely proverbs.

Another question arises: Is the American press getting fed up with radio competition in both advertising and news-distributing to the point of taking steps? In Karl A. Bickel's excellent little book, "New Empires," he says: "The broadcasting industry, somewhat conscious of its remarkable development over the past five years, is pushing along under forced draught, apparently determined to risk a newspaper break in its efforts to develop both its advertising and news fields to the furthest extent. Resentment among newspaper publishers against broadcasting is growing steadily. Newspaper antagonism to broadcasting which was smouldering three years ago, and then pronouncedly declined, is flaming up again. If the issue went to a real struggle today, unquestionably the newspaper would win and broadcasting would receive a definite setback."

Let us take the newspaper situation first, condensing a good deal of material drawn from "New Empires" and from *Editor and Publisher*, always very keen on the issue, about the attitude of the press toward the encroachment of the radio on its field.

Radio is a bit more than ten years old. The first important newspaper broadcast of news was from KDKA and covered Harding's election in 1920. The first news event to be generally broadcast was the Dempsey-Carpentier fight in 1921. By Coolidge's election in 1924 the present system was well under way, and the two great broadcasting chains are developments of the past five years. Today there are estimated to be some 14,500,000 radio sets in operation. In 1927 the newspaper publishers determined to eliminate all reference to advertisers in their radio programs but gave up the attempt after a brief and inconclusive trial. Today the question is being raised again seriously.

"The publishers of 90 American newspapers either own or coöperate in the management of radio stations," says Mr. Bickel. On the other hand, Hans V. Kaltenborn, who "edits the news" over the air, said in a recent issue of *Editor and Publisher* (February 8) that "whereas 80 newspapers owned their broadcasting stations when broadcasting first began, only about 40 dailies now have broadcasting plants." The first tie-up of newspapers with radio is said to have been due to a suggestion of a Pittsburgh newspaper which led to the establishment of KDKA and, in the main, of present policies of radio entertainment and news dissemination.

Today the National Broadcasting Company pays some three million dollars a year in telephone tolls. Broadcasting costs on the two major chains increased from $3,760,000 in 1927 to $18,729,000 in 1929. "Statistics for

the current year indicate that the total for 1930 would reach $30,000,000," according to Mr. Bickel's figures as of May 3, 1930, and according to Mr. Orton in the January *Atlantic Monthly*, advertising rates are about $4,000 an hour on the blue network of N.B.C., and $6,000 an hour over the red network. An hour on the coast to coast chain with both systems costs $20,000. A local Boston station with only a New England distribution will charge $100 for 15 minutes of a daylight hour. Evening rates are, of course, much higher. Salaries of radio entertainers are going up in proportion. The Shell Gasoline Company is said to be paying the conductor of its morning hour at the rate of $100,000 a year for three years. Rudy Vallee and his orchestra get $2,500 a week, the Firestone Tenor and Graham McNamee $1,000 a week apiece. Harry Lauder once got $30,000 for two 15-minute periods the same evening. (*Editor and Publisher* for February 14.)

This gives a little idea of the growth of the past five years and of the financial power of the two networks: the National Broadcasting Company, which is the General Electric, Westinghouse Electric and Radio Corporation of America; and the Columbia, closely associated with the Paramount-Publix theatre interests. In other words, the Power Trust and the Film Trust have strong fingers in our radio entertainment. The complete picture may be studied in another new book, "This Thing Called Broadcasting," by Dr. Alfred N. Goldsmith, Vice-President and General Manager of the R.C.A., and Austin C. Lescarboura. And in the near future we shall see the great "citadel of radio" covering the blocks between 48th and 51st streets and Fifth and Sixth avenues, housing broadcasting, television, opera, drama and films. It is to be devoted, as *The New Yorker* remarks sadly, "to opera and radio, the first of which is probably the stuffiest and least effectual form of art and the second of which is certainly the most nervous and æsthetically disappointing manifestation of science."

Anyway, radio is important. But so is the newspaper and the press in general; and the newspapers are getting peeved. They are threatening a resumption of the boycott on advertising space in the radio program columns unless newspaper advertising space is also taken. Here and there, there are signs that they are unwilling to share news with the radio. The Washington *Post* has discontinued its morning news broadcast; three Tacoma papers are discontinuing publication of their radio programs; the Minnesota Editorial Association threatens newspaper boycott on radio and calls on press associations to withhold news from the air. Conferences both in the South and on the coast start action against radio lotteries, permitted on the air but forbidden in newspapers. California publishers are looking into the matter of advertising, too. It seems to be true that while newspaper and magazine advertising fell off during 1930, radio advertising increased disproportionately. Newspapers resent particularly having to give publicity in their radio news columns to firms which have dropped newspaper for radio advertising. When they are asked in addition to give "reading notices" as news, they think it the last straw.

More serious is their contention that although newspaper advertising, for the past 20 years at least, has been clean, honest and well-regulated, present-day radio advertising, and particularly local advertising, shows all the abuses of old-time journalism. Blue sky stock advertisements that would be barred from a reputable newspaper and are, indeed, barred from the mails, flourish — over the air. Lotteries cannot be prohibited — over the air. The faker and charlatan, the quack doctor of either body or mind, the patent medicine vendor, the crystal gazer, fortune teller, astrologer, psychic, all make money — on the air. Even the large advertisers employ numerologists and astrologists instead of jazz bands to entertain the public. These, of course, offer their services free to the advertisers' public and at the same time they are building up private practice in fields which the average person of today is inclined to look upon as not entirely reputable. But the direct advertisers, the fellow who sells a stock horoscope for a dollar, the sucker stock salesman, these make money among precisely the people whom the newspapers cannot reach, the ignorant, who are powerfully moved by the persuasive power of the spoken word.

The one hopeful step in this connection is that recently the Court of Appeals of the District of Columbia upheld the Federal Radio Commission in revoking the radio license of a Kansas physician who owned his radio station, advertised his practice and hospital, made diagnoses from letters and prescribed, over the air, remedies to be bought by number at a chain of drug stores.

The newspapers also complain that at present there is no possibility of copyrighting radio material, so that a newspaper using the air for spot news or an air "extra" has no protection. The contention is that in all these matters the legal status of radio and newspaper should be the same.

ONE of the signs of this newspaper discontent has been the cavalier attitude of the newspaper sports writers toward their brothers on the air. They know that cold print the next day cannot compete with the human voice, warm and excited, of an announcer with personality, as he calls off the game play by play or the fight blow by blow. So the newspaper boys have taken to impugning the accuracy of these spot impressions. Their never-ending razzing of Graham McNamee is old sports history. And one remembers the morning when the boxing writers agreed unanimously on the bloody messiness of a major fight which, over the air the night before, had been a gentle and bloodless affair.

There is a strong body of newspaper opinion, however, that believes that radio cannot hurt the newspaper, that spot news flashes or the special sports broadcasts really do send the fan to the newspaper for more full and more considered accounts, and that there is no better newspaper publicity than the morning and evening radio bulletin, which in its tantalizing brevity sends the listener to the newspaper for the details. In the same way, these apologists point out that no one turns the dial to pick out advertising — rather he seeks to avoid it — whereas in the newspaper he really looks for it and reads it carefully. These people consider the radio a feeder for the newspaper rather than a dangerous competitor. Moreover, advertising time on the radio is strictly limited by the nature of time, whereas the paper can add advertising pages indefinitely. Nevertheless, should newspaper

advertising seem to decline in proportion to the growth of radio, or should the broadcasting companies go into the business of supplying news directly to the public on any large scale, the press will undoubtedly set itself for a battle.

SO MUCH for the newspaper and the broadcaster. Let us turn now to the more important indictment of William Orton in the *Atlantic Monthly*. It is briefly that, in spite of the high praise given by President Hoover, the Federal Trade Commission, and the broadcasting companies themselves for the high cultural quality of radio programs as developed under competitive business methods supported by advertising, more and more of the intelligent public, in whom the hopes for radio were so high, are refusing any longer to turn the dial. They are sick to death of an almost unrelieved succession of dull advertising, cheap humor, second-rate singing, and redundant jazz. The article is an attack on the traditional American philosophy which is so afraid of government regulation that it has allowed radio control to get out of hand, and big business has taken advantage of this fact. Not until 1927 was the government able even to allot channels and license stations. Today large numbers of small local stations need to be eliminated, not only because of poor programs, but because they have a nuisance power of interference far out of proportion to their direct useful broadcasting power. The courts, however, have already ruled in one case that a pioneer station may be said to have a vested interest in the air beyond the power of the Federal Radio Commission to eliminate it.

MR. ORTON points out that they "do these things better in England." "In England, this week, I could obtain at least one full orchestral program every night, including whole evenings of Bach, Beethoven, Wagner, and modern work. I could hear the Mozart Festival at Salzburg and the Vienna Philharmonic under Baumgartner. I could listen to Eugene O'Neill's 'Ile,' to a first-class debate on the international language question, to two or three recitals of modern chamber music, to a couple of revues (complete), to say nothing of dance music, political addresses, educational programs, and so on. . . . And all for the license payment of two dollars a year."

He also points out, as does Mr. Kaltenborn, that the time on the air for "unsponsored" educational and cultural programs is growing less and less, and those only in the daytime hours; that it is impossible to get time for "education" in the evenings; that time units have been steadily cut down from an hour to 30 minutes and that 15 minutes is becoming the norm; and that one can never be certain that an intelligent and interesting feature won't be replaced by one comparatively worthless because the first does not pay. (I, myself, know of cases where people bought good radios chiefly to listen to a coffee company's broadcast of the Boston Symphony, only to have it discontinued the following season and dance music substituted.)

Both Mr. Orton and Mr. Kaltenborn mention the fact that the Advisory Commission on Radio Education under the Secretary of the Interior came to the conclusion that nothing could be done for education on the air unless a fund were raised by private subscription to pay for it. The report also shows that the careful and intelligent plans of Columbia University, New York University, and the Division of University Extension of the State of Massachusetts, a pioneer in the field, to furnish genuine radio education came to nought because the commercial stations would not coöperate except by granting 15-minute snippets of time during the dull non-commercial hours of morning and afternoon.

I know from personal experience that the able efforts of the Massachusetts Department of Education to conduct radio courses have met with less and less success in past years because chain and local advertising is swallowing up all the available time. When the work started in 1923–24 the courses were very successful, by actual registrations and fees paid, and brought splendid response from the public. An account of these early experiments is given in The Technology Review for May, 1925. Today the same public exists, eager to learn, and is choked off by the necessity for advertising revenue. The big broadcasting companies profess themselves sympathetic but will do nothing. The school system is apathetic. There are some 5,000 schools equipped with radio in England and some 1,600 in the United States. Recently the Corporation Counsel of Boston rendered a decision that public school funds could not be used for radio education. Even in a large number of stations supposedly operated by educational institutions the average of actual time devoted to education on the air has been shown to be some eight hours per *week*. The rest is presumably advertising.

THE average American will not believe that Mr. Orton's chief contention, our American government being what it is, is valid. There can be no doubt that radio development in America has made its enormous technical and physical advances through private enterprise and competition. Every intelligent American knows that this method has enormous cultural disadvantages, particularly for the superior citizen. The disadvantages, nevertheless, are of the sort that can be remedied by slow and patient effort and pressure, whereas the disadvantages of government operation and control are not to be eliminated. Radio programs are better than they were five years ago. They will be better still five years from now, particularly if the present dissatisfaction with pure advertising increases and becomes vocal. But not unless the present system breaks down from extravagance and lack of revenue will our public become interested in license fees and centralized control of programs. What will happen is that the manufacture of radios will presently be centered in a few great coördinating companies with vast financial resources drawn from the electrical industry in general. Those companies will be forced to spend far more money than at present in "good will" presentations free from the present obnoxious advertising.

I hold no brief for education by radio. I do not particularly believe in its value. At best it has all the disadvantages of the lecture method of teaching without the chief advantage of that method, the immediate presence of a strong teacher who can focus interest through sheer personality. The talking picture seems to me a far more significant and potentially useful form of "mechanical" education.

(*Continued on page 422*)

THE TREND OF AFFAIRS

Colder Light

Almost all our present sources of light are hot bodies, 95% of whose radiation is invisible. To light a lamp as a source of light is about as wasteful of energy as to burn down one's house to roast one's pork. It is a fairly safe prophecy that in 50 years light will cost about a fiftieth of its present price, and there will be no more night in our cities.

—J. B. S. Haldane

HALDANE made this prophecy in 1923. What progress has been made in the eight years that have elapsed and what are the chances of a fulfillment in the next 42 years?

To both questions, encouraging answers may be given. From two different directions scientific battalions have been hammering away at this stubborn salient, and while they have not closed in, they have gained important vantage points. The chemists and physiologists are penetrating the mysteries of chemi- and bio-luminescences (approach number one) and the physicists have learned much about electrical discharge through gases (approach number two).

Courtesy Grand Central Art Galleries

"MAN OF STEEL"
BY MAX KALISH

Photographed by Bernès, Marouteau and Cie

The problem, of course, is to develop a source of light which radiates selectively, or in other words, which gives off the wave-lengths which affect our eye, emitting a minimum of those which do not. The radiation of the incandescent lamp consists of about 5% visible light and 95% invisible heat — an appallingly inefficient contraption as Haldane points out. The lowly firefly has a vastly superior method of producing light. By a process of bio-luminescence, resulting from the oxidation of a compound called luciferin, the firefly emits an almost pure, visible light with an increase in temperature of only a few thousandths of a degree.

In a radio talk delivered a short time ago, Dr. E. Newton Harvey, Princeton Professor of Physiology, discussed the subject of luminescences, with particular emphasis on the firefly's lighting plant, and gave as his opinion "that it is perhaps too soon to predict what may be the commercial future of cold light, but it is worthy of emphasis that such a development would be a very decided step in the right direction . . . the cold light of animals has been the goal of the illuminating engineer."

The statement has been made that an area of firefly light six feet in diameter on the ceiling of a room nine feet high would give ample illumination for reading or drawing on a table three feet high. It only remains for the physiologists and chemists to synthesize the firefly's tail.

The physicists, working with electrical discharges through gases, have likewise made some very promising advances, and perhaps feel equally sure that they are working in the right direction. Two months ago The Review called attention to an announcement by Claude Neon Lights, Inc., of a new gas tube for general illumination, giving an equivalent amount of light to an incandescent system using twice the energy.

From Germany now comes word of a similar development, a sodium-krypton tube four times as efficient as incandescent lamps. The light it gives, judging from the reports, is disturbingly yellowish but, nevertheless, is being used in some new lighting installations. Dr. M. Pirani, who developed it for the Osram concern, German lamp manufacturers, has announced another tube giving light indistinguishable from daylight. Its efficiency, however, is low.

Whether the efficiency of any of the gas tube lights will be sufficiently high to offset the lower production and installation costs of incandescent light is conjectural. Be that as it may, the physicists are striving mightily to fulfill Lord Haldane's prophecy. They may do it alone or they may join with the chemists to duplicate the lightning-bug's marvelous "cold light."

Color in Industry

THAT industrial fatigue can be reduced by the use of colors is indicated by the experiment of a New England shoe manufacturer, who has found that gaily painted machines and bright garments for his workers increase efficiency, help to eliminate accidents, and make happier employees.

Much thought has been given to the elimination of industrial, mental, and physical fatigue, which often is the result of monotony of scene and repeated operations. Special lighting systems and periodic rest intervals have been tried with some success, but the use of the stimulating effects of certain colors is comparatively new. Much remains to be learned about psychological reactions to color, but their effects seem fairly well established, and the further development of their use in factories may be expected.

The New England manufacturer who is carrying on this interesting experiment in color stimulation is Alfred W. Donovan, President of the E. T. Wright Shoe Company of Rockland, Mass. Aware of restlessness and fatigue among the workers in his factories during the afternoon hours, Mr. Donovan set out to relieve the unrest. He developed a theory that uninteresting and monotonous factory surroundings, with innumerable

STAIRWAY UP THE PALISADES NEAR WEEHAWKEN, NEW JERSEY

Galloway

black machines standing row on row, and the repetition of operations might well be depressing, fatiguing. After talking over the problem with a particularly high-strung and weary operator, he suggested that the man paint the machine at which he worked a bright color. The employee, somewhat skeptical, chose a light shade of green, and within a week the stimulating and restful effects of the color had produced a remarkable change in the workman's attitude. The experiment was extended to all the machinery in that particular factory, each employee being allowed to make his own choice of color. The result would have put Joseph's coat of many colors to shame, both from the point of view of varied tints and lack of taste in combining them.

The results, however, amply justified this preliminary experiment. Then Mr. Donovan called in experts, and a systematic study of the effects of color was started. A certain shade of blue was found to have a soothing effect upon workers of nervous temperament. Others were given machines painted in various delicate shades which seemed most suitable to the individual. It was also found by this study that certain colors were more effective for one class of worker than for another, and various exposures to the light were taken into consideration in the choice of shades.

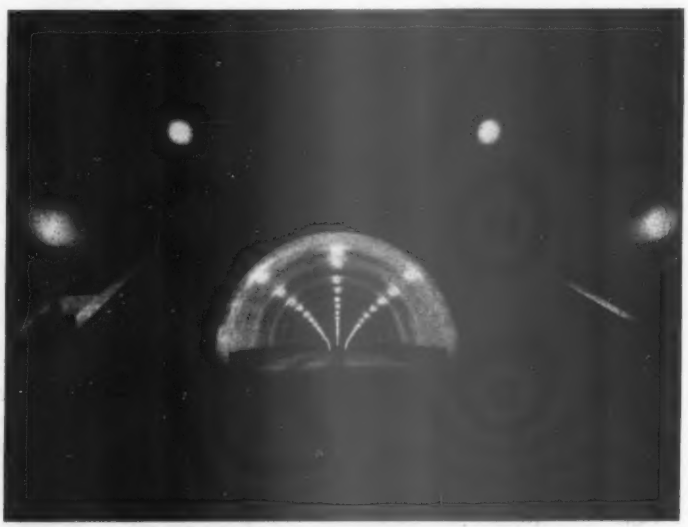
The results of this experiment, which is still going on, are, according to Mr. Donovan, increasing efficiency, with a consequent speeding up of production, a marked decrease in physical and mental fatigue, less eye strain because of the elimination of many shadows, and a much improved general attitude toward their work among employees.

Another experiment in the use of colors in industries will be undertaken with the completion of the new factory of the Simonds Saw and Steel Company at Fitchburg, Mass. This factory is to be windowless, and in many other respects revolutionary in its departure from conventional design. (An extensive account of this building was given in the January, 1931, Review.) In addition to special lighting and ventilating systems, the matter of color and its effects upon workmen is being carefully worked out. The colors for the interior have been chosen for their effects in stimulating a cheerful and active frame of mind. These include blue, green, and white for the walls and ceilings. Blue was chosen for its ability to reflect certain rays. Green is an energizing component, while white heightens the sensation of light and reflects cleanliness. Orange was selected for the machinery because of its high visibility, which will emphasize the moving parts and so aid in preventing accidents.

Glycerine, Chemical Pooh-Bah

MOST people, when glycerine is mentioned, think of it as having only three uses: for making dynamite, for making anti-freeze compounds for radiators, and for mellowing and aging forbidden beverages (perhaps this latter use should be combined with the first-mentioned one). This conception, however cheerful, is somewhat limited, for glycerine has become one of the most versatile of liquids.

It has uses that range from bread making to steel tempering; from anti-freeze solutions to sweetening marmalade. As a matter of fact, the baker and the confectioner have long used glycerine for improving the quality and lasting characteristics of bread, cakes, even currant buns, and candies. Devotees of buns, particularly the Hot Cross variety, will find satisfaction in the news that currants



THE BEAUCATCHER TUNNEL, ASHEVILLE, N. C.

Underwood and Underwood

OVAL AUDITORIUM IN THE NEW SCHOOL FOR SOCIAL RESEARCH, NEW YORK CITY. DESIGNED BY JOSEPH URBAN

treated with glycerine retain their moisture longer and, thus rejuvenated, add new delight to an old-fashioned favorite. It is quite likely that other dried fruits will be improved by the use of glycerine.

In baking, this very adaptable chemical, obtained by saponification of natural fats and oils, aids in maintaining moisture, which is an important factor in the keeping of breads and cakes. It is now believed that it also helps to retain flavors, natural and artificial, that otherwise are destroyed or impaired during baking at high temperatures.

Glycerine has attracted the attention of the physician because of its value in making marmalade for sufferers from diabetes. In this use it takes the place of sugar, and in ordinary jams the flavor, texture, and keeping qualities are improved by the addition of a certain amount of glycerine.

Eggs, as everyone knows, do not improve with age, and here, again, glycerine has proved its value. It has been found that separating the yolks and white of eggs, and mixing the former with glycerine preparatory to evaporation is an excellent method of preservation for the great quantity of eggs imported from China.

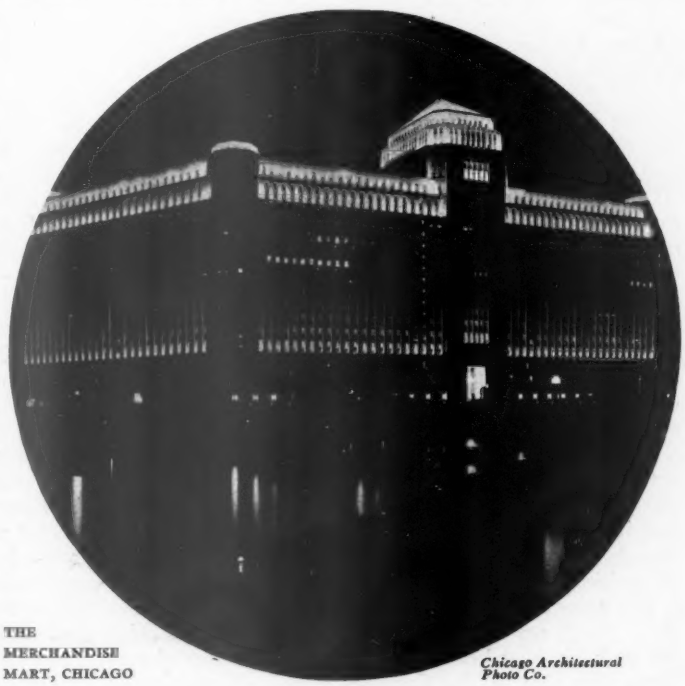
The use of glycerine as an anti-freeze in automobile radiators is not new, but recently much attention has been given to the possibilities of using the chemical alone as a cooling fluid for internal combustion engines. The advantages of glycerine are that it does not expand, its boiling point is high, it does not evaporate, and it is non-corrosive. This latter quality, incidentally, makes it useful for preserving the fine edge of razor blades, which last much longer if kept immersed in glycerine after being used. Surgeons find that glycerine not only prevents corrosion on instruments and needles, but protects them from germs. This amazingly versatile chemical has also been found valuable for storing "cold" in refrigerating units. Glycerine solutions, frozen during the working hours of shops and factories in the food industry maintain low temperatures during the night without operation of the refrigerating machinery.

One of the problems of the domestic gas industry is to remove moisture from illuminating gas before it is distributed in the city gas mains. Failure to remove moisture causes corrosion and sometimes complete stoppage by freezing. Glycerine, because of its ability to absorb great quantities of moisture, is now being used with high success as a gas drier.

In the steel industry it is widely employed as a quenching and tempering solution, the use of which gives more complete control over the hardness desired. The cooling rate of steel, for example, decreases continuously as glycerine is added to the quenching medium. The use of a proper solution makes it possible to harden no deeper than oil, while at the same time the metal is cooled more rapidly.

The Mechanization of Agriculture, or Cod-Liver-Oil Fed Chickens

IT IS just one hundred years since Cyrus McCormick made his first demonstration of a successful reaping machine. The demonstration was accompanied by the hooting and jeering of some of the onlookers; and it was not long before he was to see reapers and threshing machines destroyed by men fearful that they might lose their jobs to these new contraptions; there was the same opposition that existed to the early cotton spinning machinery and even to the cotton gin.



THE MERCHANDISE MART, CHICAGO

Chicago Architectural Photo Co.

THE BREAKING WAVES DASHED HIGH. PICTURES TAKEN DURING AND AFTER THE RECENT STORM THAT LASHED THE NEW ENGLAND COAST

Blackington

That was not an era of overproduction of agricultural products such as now troubles the economists and politicians of all nations. One hundred years ago lack of transportation took care of this. No one cared to grow more than he could use or sell to his neighbor. All the power on the farm was furnished by human beings or draft animals; and this condition was common up to a time within the memory of the middle-aged man of today.

Modern agricultural machinery really reached its development between the years 1850 and 1880. In this period were perfected the modern mowing machine, the twine binder, the cylinder thresher, and some of the modern drills and cultivators. Still the power was mainly that of animals, some few windmills and steam traction engines being in use.

Our highly specialized farm machinery is a product of the present century, and power farming, with its tractors, trucks, and electrical motors, has come into being within the last 20 years. Really, power farming is still in its infancy, but the infant is a lusty, active, and quick-growing one, and its playthings are multiplying very fast. Not only are new field implements being added almost every day, but the purely manufacturing processes on the farm are being provided with numerous new devices.

The large modern farm is developing a management system as careful as that of the modern factory. The agricultural colleges are teaching not only scientific farming, but the business principles as well. There is talk of records and costs and deterioration and profits, as well as of fertilizers and diseases and seed selection.

Not many of us who live in the cities realize the speed with which the newer methods are replacing the old. We probably have heard of the enormous western wheat farms like that of the Campbell Farming Corporation in Montana, where there are 200 skilled workmen drawing high wages, with bonus systems; and where there are tractors, combines, and motor trucks, with a well organized machine shop for their repair. Power has reached its logical application on this 95,000-acre enterprise; and it is accompanied by that characteristic of mass production methods, a system of daily progress reports, an accounting system and a cost system.

Many other crops are having the same mass production methods applied. Potato farms in Maine; cotton fields in Oklahoma; orchards in California and Florida; and elsewhere crops of peanuts and pecans, corn and soja beans — all have their special machinery, and are adopting methods of scientific management. There are machines for digging and sorting potatoes and beets, for cutting and stripping sugar cane, for sucking cotton from the opened boll by vacuum. There is even a rumor of a cranberry picker. Everywhere are power plows and harrows, power planters, power manure and fertilizer spreaders. Insecticides and fungicides are applied by power machinery, even airplanes being used. There are collectors for boll weevils and grasshoppers.

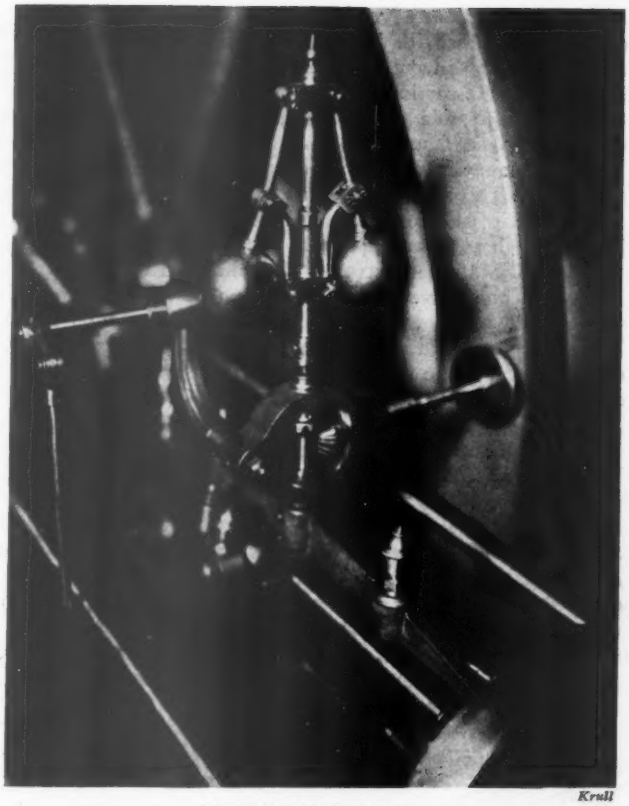
Nor are the animals and birds forgotten. Cows are washed and milked by machinery, and the milk production rate is recorded as carefully as the output of an automatic machine or the piecework record of a machine operator. Poultry are now made to work in factories from the cradle (incubator) to the grave, confined in wire cages, never seeing sunlight or green grass, being fed cod

liver oil or subjected to ultraviolet rays instead. Both cows and hens are rated on their output, and the poor producers eliminated.

The electric current is beginning to penetrate the farming community. It is bringing with it light and heat and power, communication with the outside world and news of its markets. While the application of electric power to field operations is yet to be fully developed, all stationary machinery can be electrically driven, water pumped, silage cut, feed ground and hay stored. In her house, the farmer's wife has her tasks lightened by this agency.

The advent of mechanical and electrical power on the farm was at first regarded solely as bringing a saving of human and animal labor. But now it is also being looked on from the standpoint of profits. The machine must do its work more cheaply, producing the same result, or it must do it better at the same or less cost. Statistical tables and graphic charts are beginning to appear on the modern mechanized farm. There is a thriving organization of agricultural engineers, and many experiment stations are devoting time to agricultural engineering.

The small farmer, and especially the small tenant farmer, is laboring under an increasing disadvantage. It will be the worse for him in the years to come. His experience during the year past has been pitiful. But he must go the way of the handicraft workers — either devote himself to some high-priced specialty, or enter the ranks of the operators of farm machinery. The plans of the U. S. S. R. for agricultural development foreshadow his future — the mechanical age for agriculture is just around the corner.

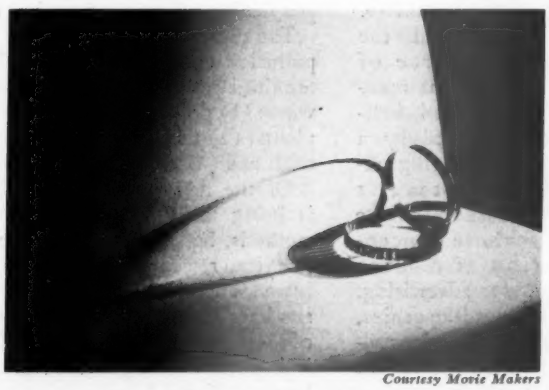


Krull

MECHANICAL STILL LIFE

Cleaning the Billboard Purlieus

YEARS ago, before the advent of the automobile, when the highways were lanes of leisurely travel, one who journeyed by horse and buggy had ample time to read the rambling message of the country storekeeper who sought to stimulate sales by listing his goods on the silvering boards of roadside fences. Out of the dusty memory of those quiet roads come crudely lettered legends about calico and cotton goods, clothing and shoes, currycombs and axle grease, kerosene and salt pork. Leaping from board to board, usually in a single line, those early forerunners of the ubiquitous outdoor advertisements of today bespoke the shrewd ideas of the late lamented keeper of the general store. His homely sales message, however, never obstructed the scenery, and carried none of the boastful, blatant claims of his successors.



Courtesy Movie Makers

SHADES AND SHADOWS

Today outdoor advertising is turning the highways into oppressive canyons with billboard walls that shut out the natural beauty of the countryside. It mounts the housetops to shriek its claims in light at night; from Bunker Hill to Golden Gate, from every highway, rouge and religion, cigarettes and shaving soap, pills and philters solicit the consideration of the passerby with insolent assurance of attention. When Gilbert K. Chesterton, the distinguished English author, visited this country recently, he was taken at night to view New York's Times Square. When asked if he did not think it a beautiful sight, he replied that he would think it beautiful if he could not read.

The outdoor advertising promoter is a modern Dædalus, "a most ingenious but execrable artist." Dædalus, you will recall, is a character in Greek mythology who was always converting mechanical skill, industry, and the arts to ill uses.

Legal attempts to regulate, in some instances to banish billboards from the horizon, have met with small success in the face of a united opposition from outdoor advertising companies. To be sure, some states levy taxes, issue permits, or exercise some form of control over billboards, but all of these measures fall short of a solution of the problem.

The great outdoor advertising companies are not the only offenders, for with the development of the offensive type roadside stand, the last resort of the hard driven farmer and more particularly of the provincial ne'er-do-well, the countryside has suffered from a plague of small signs erected on fence posts, on the trees, and rocks. They cry the merits of ham and eggs, hot dogs, and ice cold drinks. This renaissance of rural publicity is hideous compared with the humble legends of the general storekeeper of half a century ago.

James W. Martin, Director of the Bureau of Business Research of the University of Kentucky, recently made a survey to determine what states levied taxes and fees on billboards. He found that 15 states have an excise tax on billboards, while seven others specifically authorize cities to impose such taxes. Alabama, Connecticut, Florida, Georgia, Kentucky, Massachusetts, Mississippi, Missouri, Nebraska, Nevada, New Jersey, New Mexico, North Carolina, Tennessee, and Vermont are the states which impose billboard taxes; while California, Illinois, Iowa, Kansas, Pennsylvania, Texas, and Wisconsin authorize their cities to levy such taxes. In Connecticut and Massachusetts, for example, the levy is charged definitely as a highway privilege tax. Mr. Martin found that the taxation on billboard advertising is of little consequence from a revenue producing standpoint. Its purpose is to control or in a measure regulate the size and in some instances the location of advertisements.

Observation would indicate, however, that taxation or permit fees has accomplished little toward the elimination of billboards from the countryside. Control, and it is to be hoped ultimate complete elimination, of this obnoxious form of publicity may be expected to come, not through legislation, but as a result of the power of public opinion. And the force of that opinion is indicated by a growing resentment against the whole conception of modern outdoor advertising. A Dædalus-like genius, for such is the outdoor advertiser, should be taught that taste is something.

Suburbs of Hell

FROM England comes news that the annual cost of Britain's soot-fall nuisance (cause for official anxiety since the days of the first Edward) has been determined to be $4,000,000,000. Edward, in 1306, forbade the use of coal in London, an edict which became eased by the time of Elizabeth, though she, by Royal Proclamation, would not allow it to be burned during the periods when Parliament was sitting. The conditions of a few years later were described in the "Diary" of John Evelyn, one of the promoters for the scheme of the Royal Society who, in the King's Charter of 1662, was nominated a member of its directing council. Evelyn's contention in the opinion of many Londoners is as pertinent now as when he complained over 250 years ago of "the hellish cloud of sea-borne coal which maketh the city of London resemble the suburbs of hell."

From these latest observations of Britain's soot-fall, Arnold Marsh, general secretary of the English Smoke Abatement Society, derives an estimate that the annual per capita cost is 35s. While the large cities naturally exceed the average for the entire country, London shows up rather well with a per capita of 39s. Glasgow is rated at 47s., Birmingham at 52s., and Liverpool at 77s. Expressed in another way, laundry in Manchester costs $1,200,000 more per year than it would if its air were as clean as that of Harrogate.

These figures, of course, do not take into account the unfortunate effects on the health of the inhabitants from breathing the polluted air and from the cutting off of solar energy. Nor do they appear to consider the fuel savings which could be secured if more efficient combustion methods were to be adopted generally.

Turning to the situation in the United States, Pittsburgh naturally comes to mind as the classic example. There the yearly cost of grime per man, woman, and child has been reckoned at $20. However, Chicago, where the Fuels Division of the American Society of Mechanical Engineers and the Midwest Power Conference held a combined meeting some weeks since, is no backward town when judged by its baneful murkiness. On one square mile of its territory soot is said to account for a deposit of 460 tons per annum.

Under such auspices, although only one session of the joint conference had a single phase of the atmospheric pollution problem as a scheduled topic, the discussion at practically every other session referred to it.

The present approach to the problem of atmospheric pollution arising from mechanical sources, largely determined perhaps by convenience, is to subdivide it three ways: (1) products of combustion from domestic heating plants; (2) fly ash discharge from the use of pulverized coal; and (3) all other dust and fume discharge.

Of the first it is acknowledged that some progress is being made to educate the public in better firing methods, but smokeless fuel seems to be the only really practical remedy. This source of atmospheric impurity is undoubtedly a major sub-division though industrialists have magnified it through an anxiety to unload part of their guilt on the residence dwellers. Fly ash discharge is important enough to be given separate classification because of the large number of power plants utilizing

pulverized coal. It is fair though to assume that in these about four-fifths of the ash goes up the stack in extremely divided form. Actual tests show that 90% of the discharge will pass through a 325 mesh screen. Electrical precipitators collect from 85 to 90% of the solids and are the most widely used device in central station work. Fabric filters show a higher efficiency (up to 98%) but they require more floor space. (For this information we are indebted to Edward H. de Coningh, '25, of the Dust Recovering and Conveying Company.)

As to the third grouping, various kinds of equipment are on the market for the recovery of the multitude of dust and fume discharges from industrial sources. Fabric collectors find widest application especially where their adoption is accompanied by the retention of valuable materials otherwise wasted. Industries where grinding is a part of the process have installed them readily, and in metallurgical operations their power to save valuable by-product materials has convincingly proved their economic possibilities. Smelter fume, for instance, is not only an unhealthy nuisance as fee dust, but as recovered non-ferrous metallic oxides it offers tangible value.

Producing Steam with Diesel Engine Exhaust

THE use of the explosive engine in stationary power plants is becoming common practice in those sections of the United States where fuel oil and natural gas are the cheapest available fuel. There are many installations of this character in electric lighting plants, particularly in the oil-producing States. But there are other industries where there is the added requirement of steam for heating and processing; and in some of these plants, a steam boiler is provided with separate firing.

In marine Diesel installations, steam is required for the operation of auxiliaries for heating, and hot water supply; good economy is attained in such cases by making provision for utilizing the heat in the engine exhaust to heat a waste heat boiler. These boilers as designed are made up of multi-tube units, which are arranged either vertically or horizontally. The hot water from the engine jacket is used as feed water. By the use of such a boiler, the final temperature of the exhaust gases may be reduced to about 350° F., which is high enough to prevent the corrosion of exit pipes and stacks by the acids formed from the sulphur which is a usual constituent of fuel oil. Auxiliary oil burners are installed under the boiler for direct firing; these can be adjusted or shut down entirely, according to the steam demand and the amount which can be generated from the exhaust gases. These burners can be operated when the engine is not running at normal speed, as in a fog, or when, as in port or at anchor, it is shut down entirely.

A great advantage of the combination of Diesel engine and waste heat boiler is the high overall efficiency which can be attained. The engine, when running at normal speed, may show a thermal efficiency of perhaps 35 to 40% with a temperature of 500° to 750° F. in the exhaust gases, corresponding to 25 to 40% of the total heat in the original oil, depending on the type of engine, the speed of revolution, and the power output. The waste heat boiler may utilize about 60% of the heat in the exhaust, or 15 to 25% of that in the original fuel oil, the exit gases being reduced in temperature to 350° F., as specified above. This compares quite favorably with the performance of a condensing steam turbine power plant, including the use of the exhaust steam for heating or process work.

Stationary installations on land, using explosive engines with natural gas or fuel oil firing, where steam is needed for heating and process work, may well consider the use of this combination of explosive engine and waste heat boiler. Lighting plants with this installation may utilize their off-peak power by selling steam for day-time operations. Burners for direct firing should be installed where steam is needed when the engine is idle.

Where Ignorance is Not Bliss

IN THE March, 1931, issue of *Vanity Fair*, Julian Huxley (son of Thomas Huxley and author of "The Science of Life") has written on "What Science Doesn't Know," an article that is unique in its humble attitude on the accomplishments of science and worthy of the attention of the scientifically minded. It stands in marked contrast to the statements of those scientists who claim with Berthelot that "the world is today without mystery," Few there are to deny that Science tends "to clarify and to understand all things, to give them a reasonable and positive explanation," and above all to banish the "notion of the miraculous and supernatural," but the emphasis in these remarks belongs on the tendency rather than the actual realization. Regarded in the light of Berthelot, the processes of life are like the tricks of the magician; once discovered, the miracle is forgotten — the miraculous becomes unmiraculous.

It is more important to be conscious of our abounding ignorance if only that we may be distinguished from our ancestors, on whose queer ignorances we, in our sophistication, delight to dwell. Without this distinction we are but as they though we smile ever so good naturedly at past absurdities of science. No one dreamed of the possibilities of electricity — that the mariner's compass, the

Bakelite Corporation

FURNITURE IN THE MODERN MODE, DESIGNED BY PAUL T. FRANKL. NOTE THE USE OF SYNTHETIC PLASTICS AND THE NEW ALLOYS

electric cell, and lightning were all manifestations of this same electricity, to mention but one of many instances in the past.

Our greatest accomplishment has been to assemble many necessary tools for enlarging our field of knowledge. And the imaginative scientist finds a sense of exhilaration in this standing at the stairway of increased knowledge, the first step of which is the recognition of ignorance.

The specific points about which we are ignorant mentioned in Mr. Huxley's article range from whether or not the sea-serpent actually exists to the philosophic and psychological implications of growth, decay, and the development of the Mind. We do not know how to apply practicably the theories we have developed. An example of this is found in the recent glandular discoveries for which we have evolved many able theories, yet the possibility of applying these to correcting the maladjustments of human living is yet unrealized. The same is true of drugs, sex, and heredity. We have learned enough to have a tantalizing vision of man controlling Nature and Destiny to suit his desires, yet the fulfillment of this vision is beyond our present reach.

Science has scratched many surfaces, revealed many dark places, and cured many ills, but remains ignorant on one of the most important phases of biology — the nature of Mind, the relation of Mind to Matter, and its relation to the universe — all this field for research is practically untouched because its intangibility eludes scientific method, continues Mr. Huxley.

This leads to the development of new methods that will reveal subtleties — a method capable of measuring Mind. The field of discoveries then open to man's vision are limitless. He can build up new philosophies, new religions, and a new science more in accord with the era of the superman. We may be able not only to prove the existence of many things about which we have theorized, but learn to use that which we have to our greatest good. We can, to use his example, not only prove the existence of telepathy, but by controlling it obtain a weapon more valuable than sentimentality and propaganda. Brains, he claims, may not be the only machines capable of generating "high-tension mind" just as batteries are not the only way of obtaining a respectable electric potential. He continues this line of thought to the time when we may disclose that this "intensive mind" can control matter; may produce "mind-rays" able to make matter turn itself into any form to accord with the ideas in the mind, somewhat after the manner of wireless waves in radio broadcasting.

It is all an interesting matter of speculation, and presents a challenge to science. "The Earth as a mere globe is losing its unexplored secrets and each new discovery means a new adjustment of ideas and practical living. The lure of ignorance leads to the prevention of boredom and stagnation."

90,000 Words An Hour

TWO inventions which claim a tremendous increase in speed in transmitting intelligence have recently been announced. One is a device which transmits facsimile messages at a rate of 90,000 words an hour, a fact which was demonstrated by the International Telephone and Telegraph Company of London. The other is a mechanical-radio-typewriter apparatus developed by Glen W. Watson of Detroit, who claims his instrument can transmit typewritten words by radio at the rate of 1,200 letters per minute.

The instrument announced by the International Telephone and Telegraph Company passes a typewritten or printed page under a scanning beam, and the image is recorded on sensitized paper in the receiving machine. With this device facsimile messages can be transmitted by radio, and telegraph and telephone land wires, but it is not practicable for overseas cables. It reproduces only in black and white and cannot be used for halftones. G. H. Nash, executive vice-president of the International Telephone and Telegraph Company, announced that an improved model which is soon to be put into operation will transmit 180,000 words an hour.

The invention of Mr. Watson, which has been termed a radio-typewriter, employs two identical revolving contact arms which are electrically driven and synchronized. These contact arms revolve against insulated segments each of which corresponds to a letter on the keyboard of the transmitting typewriter mechanism.

Contacts with the various alphabetical segments transmit short wave radio impulses which, when picked up by the receiving apparatus, are made to operate the corresponding letter segments on the receiving typewriter.

Although Mr. Watson's device may embody new principles, this is not the first time that typewritten words have been transmitted by radio. Telegraph-printers, over which approximately 90% of the news of the country is transmitted to the newspapers by press associations, operate over a land wire system, but these machines can also be used for transmitting the typed word by radio.

The telegraph-printers used in the transmission of news are usually operated at a speed of from 60 to 70 words a minute. Where transmission speed is limited by the ability of an operator to prepare copy for transmission, such as the perforation of a transmission tape for the telegraph-printer machines, speed of transmission has its limits. Devices, some of which are already in use, for the transmission of the printed page, drawings, and photographs, may ultimately come into general use for the transmission of intelligence.

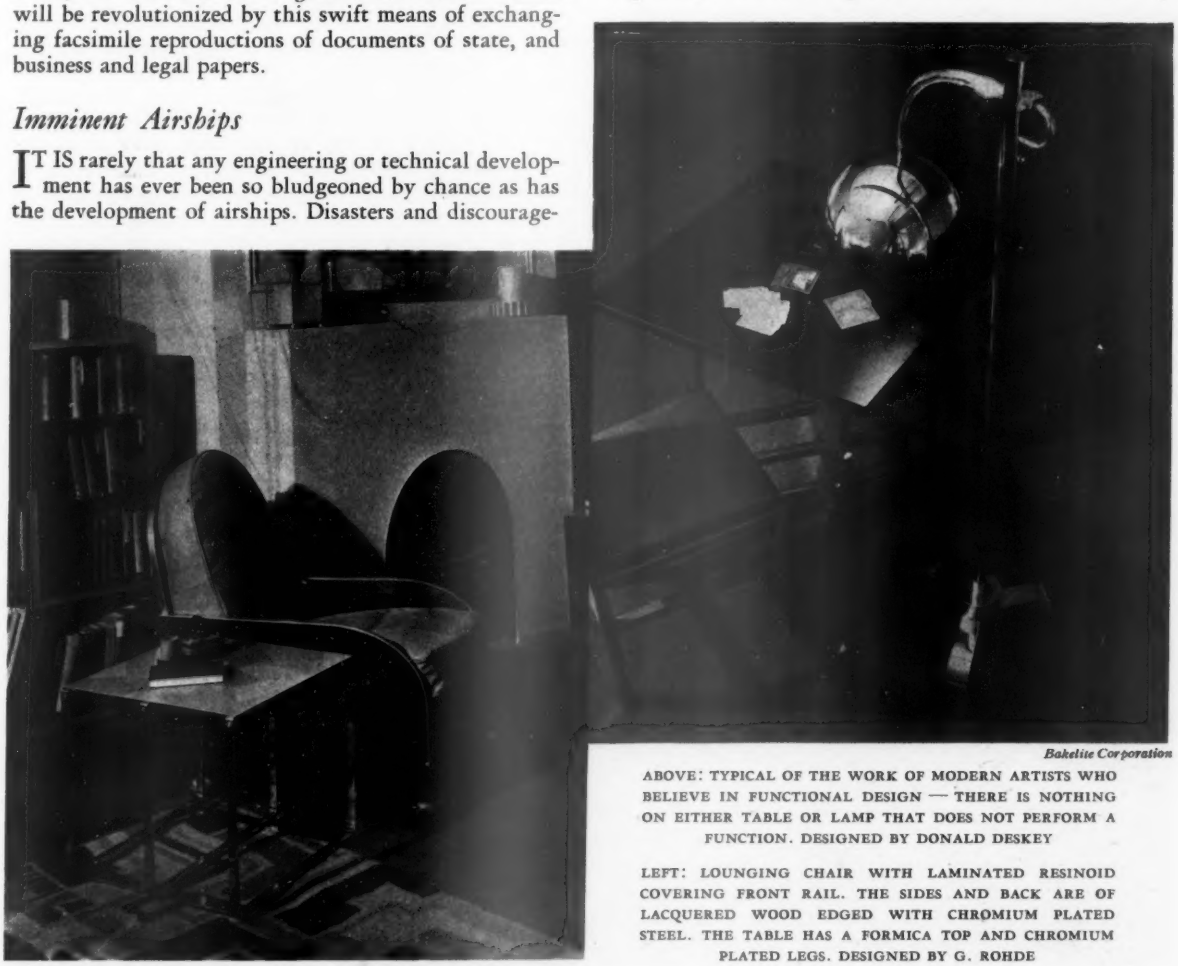
It is quite probable that within a few years the press associations will deliver news in complete, instantly transmitted pages instead of the individually typed word, and that methods of governments and commerce will be revolutionized by this swift means of exchanging facsimile reproductions of documents of state, and business and legal papers.

Imminent Airships

IT IS rarely that any engineering or technical development has ever been so bludgeoned by chance as has the development of airships. Disasters and discouragements have to date so offset spectacular achievement that in three out of five of the leading aeronautical nations of the world real activity in lighter-than-air work is simply non-existent. Yet such is the faith of certain leaders and classes of technical personnel in the other two countries that we seem on the threshold of greater achievements in this field than was ever considered possible before.

France, the birthplace and leader of all lighter-than-air activity from 1783 until the opening of the Twentieth Century, has contributed little since the loss of the *Dixmude* in 1921, save a few ships of the blimp type. Italy, which led the world in the medium sized semi-rigid type, has, since the Nobile debacle in the Arctic, abandoned all activity.

England, which has built more rigids than any other country except Germany, sits back stunned by the blow of the *R–101* disaster. Only recently has the Board of Assessors under the chairmanship of Sir John Simon, completed its hearings on that accident. The direct cause of it was attributed to a substantial loss of gas from one of the forward cells caused by the gale which ripped the forepart of the outer envelope. No evidence of unsound structure or control was found and no fault in navigation discovered. However, there was considerable reproach, or at least regret, over the fact that the ship



Bakelite Corporation

ABOVE: TYPICAL OF THE WORK OF MODERN ARTISTS WHO BELIEVE IN FUNCTIONAL DESIGN — THERE IS NOTHING ON EITHER TABLE OR LAMP THAT DOES NOT PERFORM A FUNCTION. DESIGNED BY DONALD DESKEY

LEFT: LOUNGING CHAIR WITH LAMINATED RESINOID COVERING FRONT RAIL. THE SIDES AND BACK ARE OF LACQUERED WOOD EDGED WITH CHROMIUM PLATED STEEL. THE TABLE HAS A FORMICA TOP AND CHROMIUM PLATED LEGS. DESIGNED BY G. ROHDE

had been forced into a premature departure for reasons of public policy. Although the Air Ministry has not yet made such an announcement in so many words, the entire British airship program seems dead or dormant for a number of years. Even were the remaining *R–100* inflated with helium, its shifting power would be so critically affected as to very much limit its performance; and further flight with hydrogen would be much resisted.

So different are the reports from Germany and the United States that it is difficult to believe the same subject is being discussed. The launching of the *City of Akron* or the *ZRS–4* as it is designated, is practically assured for late in June or early in July. As is commonly known, it will be of 6,500,000 cubic feet capacity, by far the largest ever launched, and will, in addition to many other advanced yet well-tested features, be equipped with five full-sized scouting and fighting airplanes. It is the first of two being built for the United States Navy by the Goodyear Zeppelin Company of which Paul W. Litchfield, '96, has been the organizer and moving spirit. Meanwhile, in Germany the *LZ–129* has been announced for launching in the spring of 1933 and will be of 700,000,000 cubic feet capacity and, in addition to being helium inflated like the American ships, will be powered with Diesel engines. Provision will be made for 50 passengers, a crew of 35, and ten tons of mail.

Even more significant than the building programs, or at least tied up intimately with them, are the advanced plans for trans-oceanic airship lines both across the North Atlantic and from our own Pacific coast to Hawaii and the Far East. It was early realized that the North Atlantic route would be an international proposition. Germany was a potential competitor and England not beyond the grounds of future development. With European labor costs and operating expenses at a considerably lower level than those which must exist for the American interests, such competition would be as difficult to meet as is the equivalent competition in ocean-going surface navigation. On the other hand, the United States has a practical monopoly on the world's helium supply. Since the holocaust of the *R–101* even the former hydrogen enthusiasts in the German camp have realized that helium must be the *sine qua non* of any airship passenger transportation. Therefore, the Goodyear Zeppelin interests early established the International Zeppelin Corporation to coöperate with European interests and to urge a bill through Congress known at the last session as the MacNary-Parker Bill which would provide protective legislation for such coöperation. This would enable the Postmaster General to contract with such a trans-oceanic airship line for the carriage of mail. Meanwhile the Pacific Zeppelin Corporation was formed on the Pacific coast for similar purposes of study and organization toward the west, yet in this case for a purely American proposition. Both companies have received great coöperation from important financial firms and from groups already engaged in other forms of transportation.

Unfortunately, pressure of other legislation prevented any action on the MacNary-Parker Bill at the last session of Congress, but the considerable reaction to it seemed generally favorable. It will, of course, be introduced and presented at the next Congress. Says Paul W. Litchfield, President of the Goodyear Zeppelin Company, "If the bill is passed, America will have ready its first commercial ship in 1934 to initiate a weekly trans-Atlantic service in coöperation with the *LZ–129*." If mail contracts can be secured on anywhere near as favorable a basis as the present contract given to airplane lines, passenger fares will be in the neighborhood of $800 for a crossing from terminal to terminal, of about 48 hours from west to east and 70 hours for the return journey.

Eugene Hutchinson

FAT STEEL RODS PULLED BY MAN AND MACHINE INTO MILES OF ANTENNA-LIKE WIRE. PHOTOGRAPHED AT THE PLANT OF THE COLORADO FUEL AND IRON COMPANY

BOOKS

Scientific Book Club Selections

BY special arrangement with the Scientific Book Club, Inc., The Review is to present each month a list of books selected by that body as meriting the careful attention of all who desire to keep abreast of scientific thought. The selections are made by an editorial committee consisting of Arthur H. Compton, Edwin G. Conklin, Kirtley F. Mather, Harlan T. Stetson, and Edward L. Thorndike.

For April the principal selection was:

THE PHYSICAL BASIS OF PERSONALITY, by Charles R. Stockard. $3.50. 320 pages. Illustrated. New York: *The Scientific Book Club, Inc.*

"Most people think of personality as the mental rather than the physical personality. Therefore the title of this book may be somewhat misleading. There is almost nothing about the mental features of personality; it deals primarily with the material factors, whether inherited or environmental, in the development of human and animal bodies. These it treats in a thoroughly scientific and scholarly fashion. Therefore it is a most valuable book for those who would understand the many remarkable advances of recent years in the fields of experimental genetics and growth processes."

Other highly recommended books obtainable from the S. B. C. are:

TAMING THE CRIMINAL: ADVENTURES OF PENOLOGY, by John L. Gillin. $3.50. 318 pages. Illustrated.

"In this book we have an important volume which will appeal not only to the professional sociologist but to every person concerned with the welfare of his fellowmen. It is a result of a study by Dr. Gillin, who, with the aid of the Social Science Research Council, spent a year in Japan, the Philippines, India, Switzerland, Belgium, and England, searching for better methods in dealing with our large criminal population. While each country has its own particular problems, it also makes constructive contributions to the science of penology as a whole, which might well be adopted in the United States, where the treatment of prisoners is tradition-bound to an unusual degree, particularly in the northern states."

THE REALM OF THE AIR, by Charles Fitzhugh Talman. $4.00. 307 pages. Illustrated.

"There appears in several newspapers of this country a daily paragraph entitled (Why the Weather), which contains significant scientific information framed in quite non-technical language. The author of this paragraph is a well-known meteorologist of the United States Weather Bureau, who for many years has been custodian of that bureau's exhaustive collection of literature. From his articles written for magazines and newspapers, he has prepared this book, teeming with information presented in an informal and almost colloquial manner, altogether delightful to read."

PROBLEMS OF EVOLUTION, by Professor A. W. Lindsey. $2.75. 236 pages.

"Of the making of books on evolution there is no end, and much reading of them is a weariness to the flesh. Nevertheless, it may be a stimulus to the mind and a guide to future research. Such is the case with this book by one who is thoroughly acquainted with all the more important contributions to the facts and factors of evolution, is broadminded enough to recognize the value of Lamarckism, Darwinism, and mutation, and bold enough to attempt to combine in an electric theory many features of these apparently conflicting concepts. . . ."

ARCHEOLOGY OF THE ARKANSAS RIVER VALLEY, by Warren K. Moorehead. $4.00. 204 pages. Illustrated.

"This latest contribution to American archeology from the director of the Department of Archeology in Phillip's Academy at Andover, is in no sense a complete treatise upon the aboriginal occupation of this significant region. Rather is it his purpose to indicate the importance of this large and almost unknown field and to suggest future and thorough exploration. To accomplish this, he describes in detail, and with a wealth of excellent illustrations, the Indian sites and artifacts which thus far have come to the attention of trained observers."

SCIENCE AND FIRST PRINCIPLES, by Filmer S. C. Northrop. $3.00. 315 pages.

"In a book of more than passing value, Professor Northrop, a member of the Department of Philosophy at Yale University, has undertaken the extraordinarily ambitious program of investigating the philosophical implications of the whole range of science and of interpreting these in the light of certain guiding principles which he feels are required by the logic of the present state of science. Although the book is intended for the layman, the technical scientist, and the professional philosopher, it will prove rather heavy reading for all three groups. The wide range of sciences and the details considered, make the book difficult for the philosopher; the many rather intricate philosophical principles raised are not easily apprehended by the scientist. To the layman, both of these difficulties will be present. However, the book is of real interest from the standpoint of the educated reader who is seeking for a unified view of nature."

ANCIENT CIVILIZATIONS OF THE ANDES, by Philip A. Means. $7.50. 586 pages. Illustrated.

" . . . Thoroughly scholarly in its breadth of view and its wealth of detail, it is written in the friendly language of everyday speech, and will appeal to the interested layman just as strongly as to the professional student. Mr. Means has profited well by the long series of journeys in Ecuador, Peru and Bolivia, which he has been fortunate enough to make. To the information thus gained at first hand, he has added the results of long and painstaking review of the voluminous literature pertaining to his chosen field of study."

11,000 TONS

Moving an Eight-Story Telephone

By William

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TOP TO BOTTOM: 1. BUILDING IN ORIGINAL POSITION, SHOWING RELATION TO OTHER BUILDINGS. 2. READY FOR JOURNEY TOWARD SOUTH. NOTE RADIAL GUIDE LINES ON RAILS AND SPLICED-OUT TELEPHONE CABLES. 3. END OF FIRST MOVE. 4. TURNED 30°. 5. STRUCTURAL STEEL FRAME

CAN our main office building be moved and turned 90° with safety, and without disturbing long distance, local telephone and house services? This question was presented to engineers by the Indiana Bell Telephone Company at Indianapolis, Indiana. Their main office building, an eight-story structure with column loads totaling almost exactly 11,000 tons, was located at the southwest corner of Meridian and New York Streets. The Telephone Company owned a plot approximately 200 feet square on which, in addition to the main office, was a smaller building used for local telephone service that could not be disturbed. All other structures on the property could be and were wrecked. A new building was planned which would satisfy the Company's needs and which was to be designed for a future extension both vertically and horizontally. The two service buildings, however, were in diagonally opposite corners of the lot, thereby leaving an S-shaped area for the development of the new building. A structure on this shaped area would not only be uneconomical and inefficient but also æsthetically an improper development opposite a park on the Fifth Avenue of Indianapolis. Thus it was that the above question was asked and, to the credit of engineering ingenuity, answered affirmatively.

Safety and service were the primary considerations, as the transcontinental cables of the telephone system go through this building, and these, of course, must at all times be maintained. Also the telephone service required the presence, within the building, of approximately 1,000 persons day and night, seven days in the week, and about four million dollars' worth of equipment. The house services, such as steam, water, gas, sewerage, elevator, and so on, were also to be maintained. The fire hazard was another serious problem which presented itself, as moving operations usually require extensive use of timber blocking and cribbing.

The building is of structural steel frame, terra-cotta arch, and brick wall construction, and measures approximately 101 feet by 135 feet with a court area above the first floor, being U-shaped. The footings at four tons per square foot rested on a very uniform grade of coarse sand. The heaviest individual column load was approximately 250 tons.

The preliminary operations involved the excavating of the plot to approximately two feet below the existing basement floor, wrecking existing basement walls of the building, driving steel sheeting along the streets, dismantling the basement partitions and equipment, providing temporary telephone and house service connections, underpinning the small building at the southwest corner of the lot, constructing column footings for the building's new location, lifting the columns preparatory to moving, and preparing the rolling surface.

The telephone cables entering the building were spliced out so as to give ample play during the move. The house services such as steam, water, gas, and sewer were maintained by means of Y-connections with valves and flexible jointed pipes or hose. These were spliced out or shortened as required. The elevator pits were reconstructed of a structural steel frame hung from the first floor framing and enclosed with corrugated sheet metal. On the subgrade of the lot a 6-inch reinforced concrete mat was placed, the surface of which was screeded level. On this mat 6 by 8-inch timber ties, 16-inch centers,

ON WHEELS

Building Without Interrupting Service

H. MUESER

Page 370

and 90-pound railroad rails at 9-inch centers were placed. These were to act as temporary grillages and distribute the building load to the sand below, at about one ton per square foot. The columns were then progressively lifted between ⅛ inch and ¼ inch by means of brackets riveted to the columns, needle beams and four 100 ton jacks, and set on distributing beams, four roller shoes, and rollers.

The rollers were 3-inch cold rolled shafting, eight under each shoe, and rested directly on the rails. The needle beams and the beams distributing the column load to the roller plates were spliced to their respective beams under the adjacent columns. This structural frame was then stiffened with a set of diagonal steel members in each bay. Upon the completion of this structural frame, the building's columns were rigidly held in position, the load was on the rollers, the fire hazard had been reduced to a minimum, and the building was ready to start its journey.

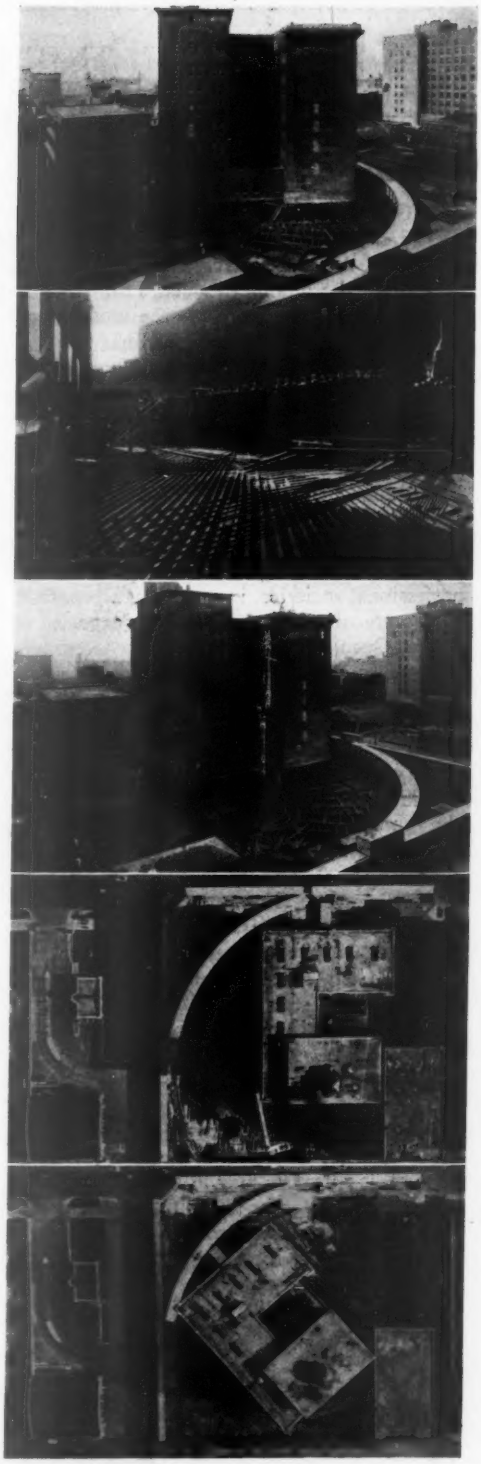
The building was first moved in a southerly direction about 52 feet, after which the shoes and rollers were reset, and then turned about a pivot point located within its own area. Upon the completion of this operation the building was in its final location. The northwest corner of the building, which was furthest from the pivot point, traveled about 224 feet in making the turn; this corner moving a total distance of 276 feet. The pivot point moved only the initial 52 feet, so that the path of each column varied between these limits.

The first move was made through the use of 18 screw jacks of 100 tons capacity, each exerting a total pressure of approximately 200 tons. The reaction for the jacks was obtained through bracing against the existing vault walls and sheet piling. The first move was completed in about four days, working a single shift and averaging 13 feet a day.

One man operated each jack by moving its handle from a vertical to a horizontal position. Upon a given signal from the foreman, all jacks were operated in unison, each man making six strokes on the jack, keeping it tight at all times. A one minute rest followed each six stroke period. With each stroke the building moved 1/16 inch, and thus the operation was continued until the throw (12 inches) of the jack had been reached. The jacks were then compressed and reset, and the operation repeated until the move was completed.

When the building reached its most southerly point, each column was again lifted and the shoes and rollers were reset. Previously the pivot point had been marked and radial lines from it had been painted on the rails, these acting as a guide for the setting of the rollers during the swing. The building was then again moved in a similar manner to that described above, except that only nine jacks were used with the help of a "donkey engine" exerting a pull through two sets of six-part sheave blocks and ¾-inch steel cable at the northwest corner of the building. The pull was 60 to 70 tons in each set of blocks. The course of the building was carefully watched both as to level and position during the turn, the latter being easily controlled by cutting the rollers under the individual roller shoes more or less as required. The resetting of the rollers took about a week and the circular swing took about 14 days.

When the building had reached its final location, the columns were again lifted, the rails and timber ties immediately under the columns removed, and the column base attached (*Concluded on page 428*)



TOP TO BOTTOM: 1. TURNED 60°. NOTE LOCATION OF JACKS. 2. GENERAL VIEW OF PULLING ARRANGEMENT. 3. FINAL POSITION — VIEW SHOWS SIDEWALK BRIDGE. 4. AERIAL VIEW AT END OF FIRST MOVE. 5. DURING OPERATION CLEARANCE BETWEEN TWO BUILDINGS WAS 2½ INCHES

Open House: 1931

EIGHT years ago the Institute opened its doors for general public inspection on its first Open House Day. A comparatively small group of Alumni and a handful of the public attended. From that small beginning, Open House, which is the work of the students' Combined Professional Societies, has become one of the most valuable and interesting of Institute affairs. Last year, Open House Day was reserved for those who attended the All-Technology Reunion. This year, on Saturday, May 2, Technology will again open its doors to the public for a great scientific and engineering exhibition. In 1929 more than 20,000 persons attended Open House, and at least that number is expected this month.

The Combined Professional Societies, which is composed of the student chapters of the various national professional societies, is arranging a program of exhibits and spectacular features which are expected to make this year's Open House more comprehensive and interesting than ever before. A Faculty committee appointed by President Compton is coöperating with the student leaders in arranging the program.

As May 2 is the day of the triangular crew race between Princeton, Harvard, and the Institute oarsmen, this much anticipated event will take its place as one of the interesting features of the day. Every Department is to arrange special exhibits or experiments, and the various student activities are planning features which will illustrate the important part they play in the life of the Institute. In addition to many spectacular experiments, including a hook-up of every modern method of communication, the Department of Electrical Engineering will pay its tribute to the memory of Michael Faraday with a special exhibition of such electrical apparatus as Faraday employed in his early experiments. This year is the one-hundredth anniversary of Faraday's discovery of electromagnetic induction. Recent developments in science and engineering will be demonstrated by special exhibits in the Departments of Chemistry and Chemical, Aeronautical, Civil, Mechanical, and Mining Engineering, as well as the Department of Biology and Public Health. The Department of Physics is already working on apparatus for its exhibits and experiments, and the Department of Building Construction is arranging exhibits to illustrate the latest methods in building construction.

Bachrach

BRADLEY DEWEY, '09, WHO HAS BEEN NOMINATED TO THE PRESIDENCY OF THE ALUMNI ASSOCIATION FOR 1931–1932. SINCE ONLY ONE CANDIDATE IS NOMINATED, NOMINATION IS EQUIVALENT TO ELECTION. MR. DEWEY IS PRESIDENT OF THE DEWEY AND ALMY CHEMICAL COMPANY, CAMBRIDGE, MASS.

The 151st Council Meeting

IT IS an old Technology custom that the Faculty Club meet with the Alumni Council once each year. It is also a custom that for these joint meetings the program, save for the few necessary business items on the part of the Association, be planned and presented by the Faculty Club. Both of these customs were observed on the evening of March 23 at Walker Memorial when the two bodies met to hear a discussion on comprehensive examinations.

Donald G. Robbins, '07, Vice-President of the Association, presided over the meeting during the business session. At his call the Secretary presented the report of his activities, together with a summary of the reports presented to the Executive Committee by the Treasurer of the Association and the Publisher of The Review. Preceding these reports Chairman Robbins called on Charles E. Merrell, '88, guest of the Council from Cincinnati, to present greetings to the Council and Faculty Club from his home town.

Vice-President Robbins then turned over the meeting to Professor Dean Peabody, Jr., '10, President *pro tem.* of the Faculty Club, who introduced Dean Clifford H. Moore of Harvard and Professor Leon B. Richardson of Dartmouth. Each of these speakers spoke at length on the subject of Comprehensive Examinations, giving their experiences in their respective colleges. Dean

Moore said that the system was inaugurated at Harvard in 1916, to date over 5,000 examinations had been held, and the failures amounted to 8.5%. The results are felt to be very satisfactory, in that such examinations tend to round out and correlate the students' knowledge.

Professor Richardson stated that their Dartmouth experience had been over a period of only two years, but that they were optimistic over the scheme. One interesting point which he brought out was that this is nothing new, as comprehensive examinations were a regular thing at Dartmouth over the period from 1828 to 1875.

Following the two addresses Chairman Peabody called upon Professors Jackson, Millard, and Prescott to comment briefly on the subject. Professor Millard confessed that in the Chemical Department on the next day they were trying, with some fear and trembling, an initial comprehensive examination. General discussion followed, and finally Dr. Compton closed the meeting by stating that in his opinion all who were present were much impressed, like himself, with the possibilities of holding comprehensive examinations.

Ninety-seven members of the Alumni Council and Faculty Club were present.

Corporation Visiting Committee Reports

ONE of the administrative policies of the Institute in recent years has been to give the different departments of the Institute an opportunity to obtain advice and coöperation from leaders in the industries for which the departments train students. Accordingly, there have been created the Advisory Committees that meet with Faculty members of the departments to discuss educational and industrial needs.

To supplement this system of Advisory Committees, there are also Visiting Committees composed of members of the Corporation. These committees contribute much to the better understanding between the Corporation, the Faculty, and the industrial world. The Corporation, wishing to publish and emphasize the reports and transactions of the work of these committees, has asked that they be presented in The Review. Many have been published in the past years and to these are added two more, presented below, covering (1) the Department of Architecture and (2) the Departments of German, Romance Languages, and English.

REPORT ON JOINT MEETING OF THE VISITING AND ADVISORY COMMITTEES OF THE DEPARTMENT OF ARCHITECTURE*

AT A called joint meeting of the Visiting and Advisory Committees of the Department of Architecture a careful analysis of the status of the Department resulted in the adoption of the following decisions and recommendations to the Corporation.

Before outlining the Committees' conclusions under the various headings of the agenda, we wish to record our deep appreciation of the splendid gift of Mr. and Mrs. William Emerson for scholarship aid. The funds thus provided, together with monies made available by the Executive Committee, are of incalculable benefit in making possible the education of many who are destined to take leading places in the ranks of our profession who otherwise would be unable to obtain these advantages.

Your Committee also wishes to state that it was deeply impressed by the intimate and personal relationship between the student body and the instructing staff, and by the *esprit de corps* of students and teachers under the sympathetic leadership of Professor Emerson.

Considering first the frequently recurring suggestion from practicing architects that a certain minimum of office practice be made a prerequisite for a degree, it was decided after full discussion that, while highly desirable, and to be advocated along with foreign and domestic travel, it was a requirement which lay outside the Department's jurisdiction and an attempt to enforce it might result in the unwarranted loss of a degree.

The Committee approved in principle the division of students in fourth and fifth year classes on the basis of their scholastic standing, such division to be altered or adjusted each half year. The details to be worked out to suit conditions as they arise.

While the problem is by no means a new one, its increasing importance leads your Committee to strongly advocate sending the teaching staff from Cambridge to the Rogers Building for first, second, and third year courses, rather than recommend the costly alternative of furnishing transportation of the student body to Cambridge. This plan should be made universal except for the teaching of certain subjects in Course IV-A.

A comprehensive review of the history of the Department of Architecture covering the last ten years reveals:

(1) A constantly mounting enrollment (from 119 in 1919 to 301 in 1929)

(2) Important changes in the Course Schedule of great benefit to the student

(3) The supplanting of the four-year course by the five-year requirement, not only without producing adverse comment, but without checking the enrollment

(4) The following record of achievement by our students in the winning of coveted prizes and scholarships — 2 Paris Prize Winners in three years, Winners for three successive years of the Rotch Scholarship and of the Guy Lowell Scholarship, Winners of the Stedman and Le Brun Scholarships and first holder of the newly established Kelly Scholarship

(5) Striking improvements in the methods of teaching Design and History and the correlating of Design, Color, and Modeling

(6) A greatly improved system of relationship between the Library and the Student

(7) This statement would be imcomplete without a tribute to the inestimable value of Professor Carlu's services in Design — he has coached three Paris Prize winners in five years.

Certain difficulties having arisen in the operation of the Honor System, the whole subject was referred to the Student Council. The recommendation of the Council that the Honor System be discontinued was reluctantly concurred in by your Committee.

*The Visiting Committee of this Department consists of: Harry J. Carlson, '92; A. Lawrence Lowell; and A. Farrell Bemis, '93. The Advisory Committee consists of: John C. Bollenbacher, '09; William A. Delano; Frederick W. Garber, '03; Robert D. Kohn; C. Grant Lafarge, '83; William S. Parker; Arthur W. Rice, '91; William J. Sayward, '01; Arthur A. Shurtleff, '94; and Frank R. Walker, '00.

Your Committee is in complete accord with the desire of the teaching staff to create a more intimate connection between the various subjects and Design itself; to consolidate several of the short courses into a fewer number, and most important of all to foster the teaching of Abstract Design as a fundamental to all instruction in designing.

Your Committee was highly gratified with Professor Lawrence's statements as to the purposes of Course IV-A and the results he is achieving and in particular with the declaration that his main object is to create a sympathetic attitude of the architectural engineer to the problems of the architect, and *not* to create "designers." The Committee recommends that Geology of Materials, which is now taught only in Course IV-A, be included also in Course IV, and that the outline instruction now given in the Mechanical Equipment of Buildings, be retained as of value in a well-rounded comprehension of modern building problems.

After full discussion it was decided that highly specialized training of professional men in either of the Department's courses would be a grave error.

Rather than create a special committee to aid Department heads to secure opportunities for employment in architects' offices, your Committee pledged the coöperation of the profession in responding to every request of Professor Emerson.

Since your Committee is convinced that timely financial aid is of such inestimable value to promising students, and so in turn to the profession, the question arose and is here submitted for your consideration, as to whether any of the Institute's publications, such as the brochure on the Department, could carry a statement of, first, the need; second, the benefits accruing; and third, the designation of the agency (the Chandler Fund) through which gifts and bequests could accomplish the desired purpose.

Respectfully submitted,

JOHN LAWRENCE MAURAN, '89

REPORT OF THE VISITING COMMITTEE OF THE DEPARTMENTS OF GERMAN, ROMANCE LANGUAGES, AND ENGLISH*

In this, the first report of your Committee since the death of James Phinney Munroe, '82, we desire to express our sense of the great service rendered by him as Chairman of this Committee from 1902 to the time of his death. During this period of more than a quarter of a century steady progress was made in giving recognition to the cultural studies in the Institute program, and in integrating them with the rest of the curriculum; at every stage in this progress his sympathetic understanding of problems, through his constant contact with Alumni, students, and members of the Faculty, made his advice and his assistance of the greatest value.

Your Visiting Committee on the Departments of German, Romance Languages and English desires to report that on Monday, January 20, 1930, it held a meeting with the President of the Institute and Professor Pearson, head of the Department of English and History, and has gone over the problems confronting the department with a good deal of thoroughness.

*The Visiting Committee of the Departments of English and Modern Languages now consists of: Pierre S. du Pont, '90; William H. Bovey, '94; W. Cameron Forbes; and Payson Smith.

At the Institute there is no grouping of departments in such a way as to have a single head over English and other languages, and your Committee will beg leave to make a report upon matters relating to other languages at the Institute at a later date.

In 1924 the Visiting Committee made a report in which it recommended a conference of colleges to see if joint action of many colleges could be secured in regard to stimulating an understanding of the importance of the correct use of English and emphasizing the necessity for general action upon it. Although such a conference has not been held there is no question but that the objects sought to be achieved at that conference have been accomplished in an important measure at the Institute of Technology. These objects have been in part: work tending to facilitate public speaking on the part of students; segregating them in small groups not exceeding ten in number, with periodic meetings, at which one addresses the group and then all join in debate; an effort to have the teachers understand the value and importance of speaking and writing good English and to have particularly those in the technical departments impress upon their students the necessity of clear and concise expression and accurate wording of their documents and reports; and means for bringing men who had defective training in the past up to a better understanding of the use of their own language.

Both Dr. Stratton and Professor Pearson were of the opinion that there had been marked progress made in teaching English and in the acquisition of its use by the students of Technology, and your Committee begs to recommend that the President and Faculty adopt as a rule of the Institute that in all courses the policy be established of not accepting written work that is not satisfactory in point of English. When it is clearly understood by both instructors and students that, no matter how great the technical excellence of the paper, if the form of its presentation is bad it will not be accepted, there will result a much to be desired improvement.

The question was asked whether it would be well, in selecting new instructors and in promoting those already on the staff, to give special attention to their knowledge of English and their realization of its importance. President Stratton informed the Committee that this was part of the established policy of the Institute; that it was responsible for a good deal of the progress shown; and that it was proposed to lay continued emphasis upon this necessary consideration.

Your Committee feels that to secure the best results in this Department a moderate increase in the salaries paid to the instructors is important, if not imperative. . . .

Your Committee desires to put on record its belief that mastery of one's own language is self-evident and fundamental and that the importance of such mastery cannot be over-emphasized.

It also wishes to record its approval of the method authorized by the Faculty and in effect for the last ten years of using the cultural instruction in history and in literature given by the Department as the basis for the training in English composition.

Respectfully submitted,

W. CAMERON FORBES
F. W. FABYAN, '93

(*Continued on page 426*)

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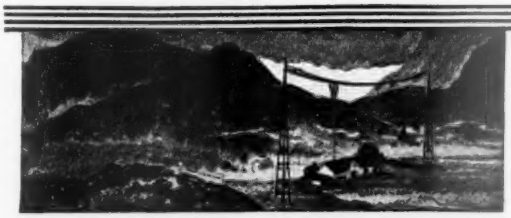

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DOODLE-BUGS DEPOSED

(*Continued from page 378*)

For the location of oil, the magnetometer has been widely used, but not always with uniform success because of the tendency to extend its use to areas better adapted to some other device. The cheapness of the instrument, low cost of operation, and the ease of manipulation make it an attractive means of surveying. Its best field of application is undoubtedly concerned with large, deep-seated mountain ranges of granite or other highly magnetic materials. The low magnetic content of upper sedimentary rocks does not present anomalies of sufficient magnitude to be distinguished from errors of observation. A satisfactory plan would be to use the magnetometer for reconnaissance work, leaving the detail to some more appropriate instrument.

The gravimetric method of exploration immediately suggests the principle of its operation: the variation of the force of gravity by geologic structures. The magnitude of this force is proportional to the mass producing it and varies inversely with the square of the distance from it. The direction of gravity would be practically vertical if there were no irregularities in the earth's crust to distort it. The classification and measurement of these local anomalies form the basis of gravity surveying. Observations of the magnitude and direction of the distorted field point the way to the disturbing element. Usually the anomaly is presented by a mass of higher than average density, but masses of low density also offer possibilities. Topographic variations affect gravity measurements, and when possible, their effect must be computed as a correction to the observations.

In practice, most of the gravity surveying in the Southwest is done by the use of the torsion balance. This highly developed instrument measures the change of gravity in horizontal directions, showing the horizontal gradient and the departure of lines of force from normal. It is illustrated by many commercial forms and, in general, consists of a torsion pendulum of two weights, so related that only the horizontal component is observed. The torsion balance has found wide use in oil field exploration with varying degrees of success. The interpretation of the observations is an extremely detailed and complicated process, depending to a great degree upon the skill and experience of the interpreter. Without adequately trained personnel, the results of this work are likely to be unsatisfactory.

Its greatest success has been found in the Gulf Coast region. Here the large irregularities presented by salt domes protruding up into the surrounding alluvium make possible rapid and satisfactory interpretation. In areas of complicated geology, the success of the torsion balance has not been universal beyond the location of large, deep-seated mountain ranges. Further research may develop the instrument to a more universal utility if present tendencies continue. Surface irregularities cause confusion in making interpretation, particularly when corrections are unavailable. (*Continued on page 410*)

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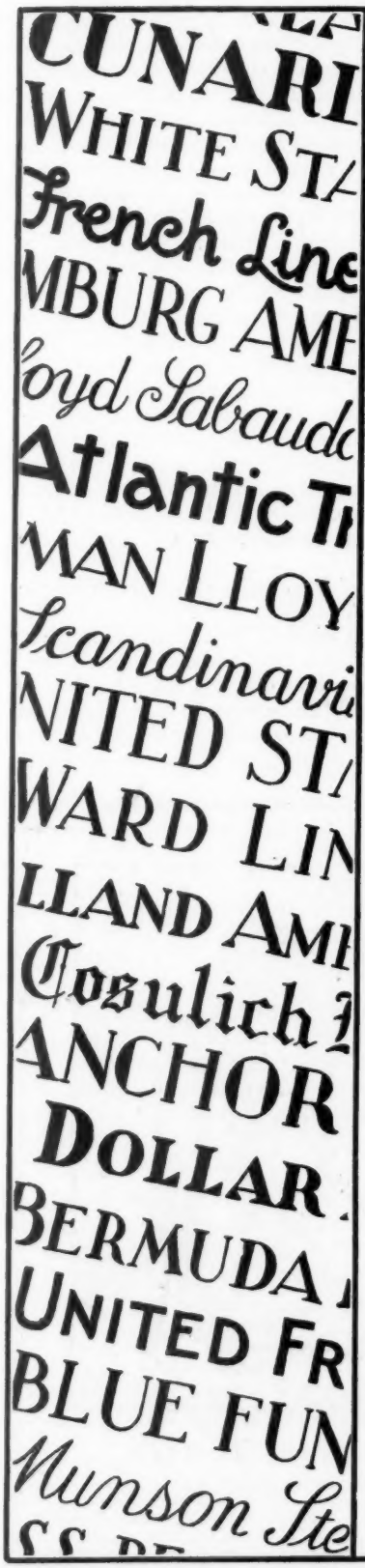

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DOODLE-BUGS DEPOSED

(*Continued from page 406*)

The seismic method of exploration has rapidly grown to a large and important position in oil location. From an experimental beginning in 1919, the various systems of this type have received continued improvement, and today the method offers the greatest immediate promise of widespread usefulness. The instruments are an adaptation of the earthquake seismograph, which records vibrations of the earth's crust originating at some distance from the point of observation.

In the location of oil by this device, a charge of dynamite is exploded at a suitable point, which sends out in all directions a miniature earthquake, or seismic wave. Some of these waves travel along the surface of the ground to the recording device, located at some distance from the dynamite. Other waves penetrate into the earth, striking the various rock formations in their path. Following the laws of light and sound waves, these impulses are refracted and reflected, thereby returning in part to the surface recording device. The exact time of the explosion being recorded by electrical or other means, it is possible to determine how long the waves required to complete their journey downward and return. The echo from subsurface formations makes its own record on the instruments, and from these records it is possible to compute the depth of the refracting or reflecting horizons. A detailed map of the formations is obtained by moving shot point and recorders over the country.

The seismic method has grown to become the most versatile of all geophysical methods. Accurate corrections are made for topographic conditions as it is equally useful in delineating shallow (20 ft. to 2000 ft.) or deep features (up to 20,000 ft.). There are few regions where the method will not give indications of some value. So long as there is some formation having greater hardness and rigidity than overlying members, refractions or reflections can generally be obtained. The total cost of operation is greater than that of other methods, but its ability to give reliable data more than offsets this disadvantage. It is a method more suited to the detailed survey of considerable areas, rather than a casual application to a local section. It appeals to the geologist very strongly because it is at present the only method which presents the results of a survey in terms with which he is accustomed to dealing. The accuracy of the observations is equal to that of measuring well-drilled holes. Ultimately, the seismograph gives the geologist the same kind and amount of data he would obtain from a well log compiled from sample cuttings. Wells cost from $15,000 to $500,000. The seismograph reports a depth for $100 to $150.

Of course it is not fair to make a comparison on the basis of one depth. A rancher, whose land was not far from a prospect being surveyed by a seismograph crew, inquired how many shots it would take to cover his land. He had been watching the work, and had a fair idea of the cost of the shots. When he was told that six or seven would be sufficient, he was at once very anxious to have the crew come over on his property (*Continued on page 412*)

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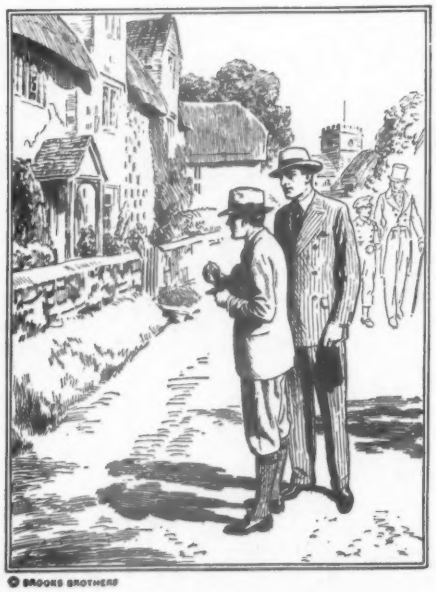

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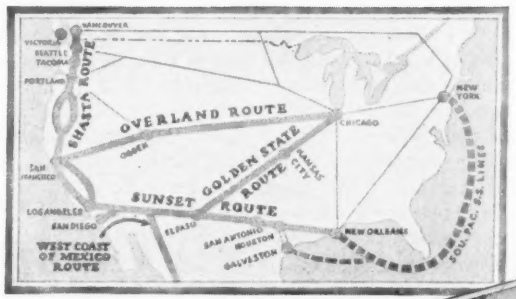

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DOODLE-BUGS DEPOSED

(*Continued from page 410*)

and work. It was hard to explain to him that he would be wasting his money because the information taken on his land was worth little unless it was tied in with similar data taken throughout the neighborhood. Any geophysical survey depends for its success upon the accumulation of considerable data and the correlation thereof with known geology.

THERE is another form of prospecting for oil which has given considerable service in some areas, an extension of surface geology by the use of the core drill. In regions where surface outcroppings are lacking or unreliable, some success has been achieved by drilling through the shallow beds to one or more reliable markers. If such markers can be found a few hundred feet below the surface, core drilling is considered to be very satisfactory. Provinces of this kind are comparatively rare, however, and in many sections it is necessary to core to one or two thousand feet in order to find a widespread common datum. The core drill, as its name implies, cuts a cylindrical core from the rock formations, which are classified and logged by geologist or paleontologist. Structural indications found on these data are assumed to indicate similar and deeper structures whereupon oil may have accumulated.

The cost of core drilling varies with the hardness of the rocks being drilled and it is difficult, therefore, to estimate the average cost of such work. In the Mid-Continent fields, costs run from $1.00 to $1.25 a foot for shallow coring (500 feet); these figures may rise to $2.00 a foot at depths from 1,500 to 2,000 feet. In contrast with this type of work, it is striking to point out that seismographs work to depths of 12,000 feet or more for a cent to a cent and a half per foot.

An understanding of the operation of the seismograph is most easily developed by a description of its construction and principles of operation. The earliest instruments were very much like earthquake detectors. A large mass, suspended from a light, rigid case by means of springs, was so arranged that the relative motion between the two could be recorded. The instrument was set up on the surface of the ground, protected from wind and disturbances by means of a small tent. The motion between the mass and case was transmitted mechanically to a small rotating mirror, which made a photographic record by the reflection of light upon a moving sensitized film. A clock mechanism provided means of time measurement, recording its intervals on the same film. Early developments depended upon the use of a stop watch at the firing and recording points. At a predetermined time a charge of dynamite was exploded and at the same time the recording instruments were in adjustment to receive the impulses. This arrangement, called the mechanical seismograph, is now largely superseded by the electrical type.

Even with relatively crude apparatus, the seismograph gave an early promise of successful performance. To make it more adapted to the requirements of petroleum exploration, it was necessary to increase (*Continued on page 414*)

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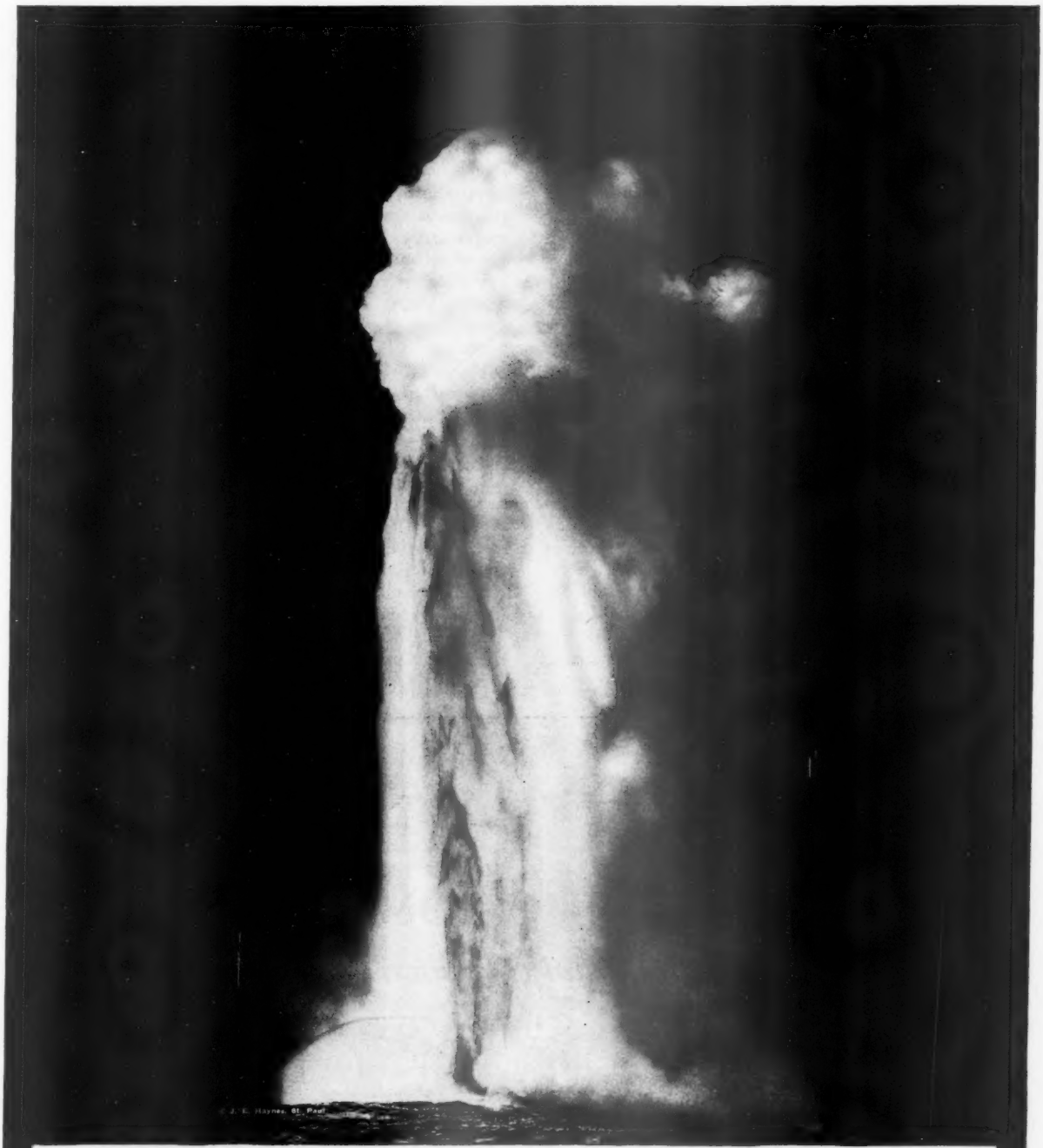
Reserves and all other liabilities	541,320,308.97
Surplus of Assets for Emergencies	42,801,504.44
Income Received in 1930	154,381,579.65
Added to reserves during the year	35,007,828.00
Paid to Policyholders	75,121,420.00
Total Paid Policyholders in 68 Years	681,561,755.00
Invested on Policyholders' Account during the Year	82,300,519.03
Dividends paid policyholders in 1930	18,620,863.25
Reserve for policyholders' dividends in 1931	20,220,000.00

A. G.



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DOODLE-BUGS DEPOSED

(*Continued from page 412*)

its depth range, resolution of adjacent formations, and, above all, its accuracy. These features were difficult to develop in mechanical instruments and accordingly the electrical type was invented. In this system multiple recording seismometers are employed, each of which is connected by cable to a central recording station. By radio or telephone, the firing point and the recorders are in constant communication, thereby recording the exact instant of the explosion on the moving film. The inaccurate timing of the old system was one of the principal weaknesses. Today time measurements are made to an accuracy of one one-thousandth of a second through an application of sound electrical engineering principles. As a result of this development, we now find depths being measured with an accuracy of one half of one percent.

The detectors of the earth waves, called terraphones, geophones, or seismometers, are electrical devices designed to convert the effect of ground motion into an electric current. Microphone buttons, condenser transmitters, electromagnetic instruments similar to radio loud speakers, are some of the forms which have been adapted to this purpose. Each seismometer receives impulses from the explosion and transmits them electrically to the recording station, where they are amplified by vacuum tubes and recorded on the film by galvanometers. The distance between the firing point and recorders, as well as the respective sea level elevations, completes the data required for the computations.

The method of procedure in geophysical surveys is well adapted to the needs of a production job and is by no means an experimental undertaking. All of the movements of the crew are well laid out in advance, for a definite schedule must be maintained regardless of weather conditions. About the only thing that has actually prevented field operations throughout the past five years has been a tropical deluge or one of the famed Panhandle blizzards. In spite of apparently unbearable field conditions, the work has steadily progressed, even in the swampy lands of Louisiana, where considerable maneuvering has been accomplished in boats and pirogues.

For the greater part, this type of work is very attractive to young engineers and technical graduates. A seismograph crew offers a wide variety of interests and a promise of a lively and profitable career. There is considerable moving about the country, with a delightful combination of healthful out-of-door work and genuine scientific endeavor. A seismograph party is a well-coördinated unit, each individual's activities dovetailing into the others' with a maximum degree of coöperation. All of the technical men have real personal responsibilities and for that reason, men of somewhat better than average ability are frequently found in this work. This condition prevails because of the impracticability of maintaining detailed supervision over each man. In general, the remuneration is in keeping with the difficulties and responsibilities of the position.

In charge of a crew is the party chief, a man of mature judgment, some graduate training in physics or electrical engineering, and a capable leader (*Continued on page 416*)

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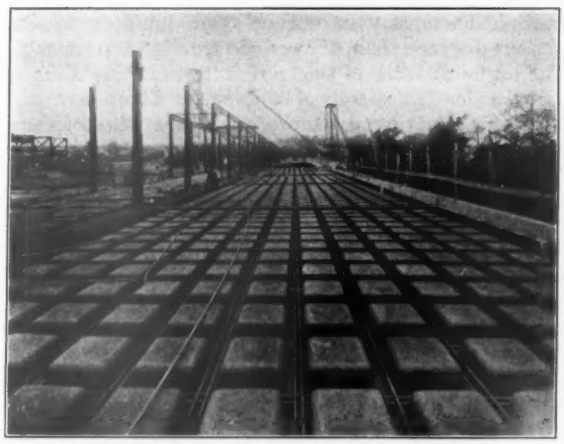

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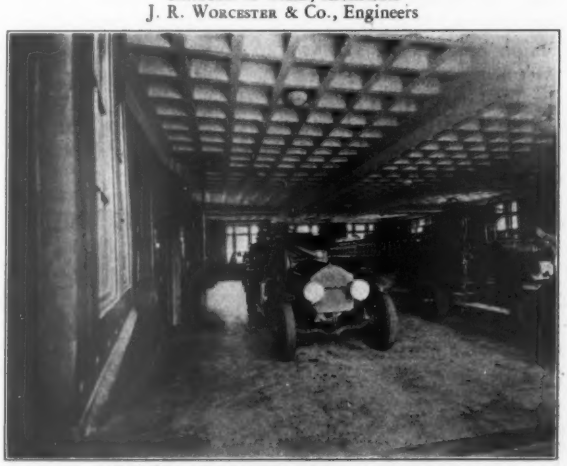

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DOODLE-BUGS DEPOSED

(*Continued from page 414*)

of men. The field crew is under the immediate supervision of the chief observer, who is likewise technically trained. There may be one or more junior observers if there is more than one set of recording instruments. The technical work of the crew is facilitated by a labor crew, under the charge of a foreman. These men dig holes for planting dynamite, place the seismometers and cables in position nuder the direction of the chief observer, and carry on general roustabout service. A shooter, trained in the matter of handling and planting dynamite, supervises the procedure at the firing point. A surveyor and his rodman lay out positions in advance and advise the chief observer where he is to work. An average day's work consists of from three to five depth points.

A survey of the applications of geophysics during the past seven years shows a rapidly widening field of usefulness. In 1924 the first extensive commercial applications of the seismograph were begun. Two salt domes were discovered on the Gulf coast in this year. Nineteen twenty-five saw the discovery of four more. In 1927, there were 26, and in 1929, there were 35 domes reported by torsion balance and seismograph operators. During the twelve months just elapsed the appropriations for geophysical work have increased three times the amount spent during the previous year. At the present time the growth is still increasing in spite of the overwhelming depression of the oil industry.

In contrast to this unprecedented growth stand the decreasing appropriations for strictly geological methods of exploration. Practically all producing companies have been obliged to reduce the scope of their geological departments on account of the superabundance of oil and the prevailing low prices. Today it is cheaper to buy oil at the open market than to drill and produce it. If this is so, what warrants the increasing expenditures for geophysics?

For one thing, geophysical methods have proved their ability to seek out oil pools with considerable success when guided by intelligent manipulation. The percentage of failures of these methods has grown less each year of their service. Scores of technical men have become experts in the art of interpretation and their experience has become a major factor in the reliability of the methods. Geologists have come to regard geophysics as a friendly aid to their own endeavors rather than a hostile competition. Through its use, the range and value of geologic data have become increasingly valuable. Progressive executives, quick to estimate the economic phase, find it valuable in guiding their policies of lease distribution. Even if no oil is found, geophysics often earns its fee many times over by the scientific selection of existing leases into good and bad.

The biggest factor in the present rate of growth is caused by its own momentum. Nearly every major company has some large part of its development work devoted to geophysics. The companies regard each other keenly, for no chances may be lost in this game. Everyone must give the new science a (*Concluded on page 418*)

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WHEN THE GARDEN DOOR OPENS

Soon frozen lumps of lawn will thaw into welcome green, and gunny-sack cowls will be stripped off the rose-bushes . . . soon red and yellow sparks of tulips will burst into flame under the May sun. . . . When you've opened the garden door for the summer—let it open on a world of bloom that lasts till the frosts of Autumn. Clouds of roses, dashingly brilliant zinnias, strange varieties of lilies from distant lands—House & Garden will tell you how to plant and care for every flower.

House & Garden will help you plan your whole gardening season—so there'll be no lapses in mid-August when you'd have to blame the heat for scarcity of bloom. House & Garden will show you garden furniture for lazing under the evergreens, and help you make those jaunty summer curtains and slip-covers that seem to grow a garden indoors.

House & Garden will not fail you—in the details, or in the important decisions about building, or decorating, or gardening. Send in the coupon to-day for a five months' subscription. The price is only $1—a small premium to pay for a whole summer of charm and beauty in and about your home.

SPECIAL OFFER TO NEW SUBSCRIBERS ONLY

5 ISSUES OF HOUSE & GARDEN FOR $1

House & Garden, One of the Condé Nast Publications, Graybar Building, Lexington at 43rd, New York City

☐ Enclosed find $1 for 5 issues of House & Garden ☐ Enclosed find $3 for 1 year of House & Garden

NAME STREET

CITY STATE JLM-3-31

DOODLE-BUGS DEPOSED

(Concluded from page 416)

trial, and the gratifying feature of this trend is the continued success which comes after a fair trial. True, a few may casually inquire and discard the method after a hasty examination, but these occurrences are not the rule. Geologists who become intimately familiar with geophysics are intensely enthusiastic after their first acquaintance and thereafter no other method seems adequate. By leaps and bounds, this new science has reached a place of permanent importance.

THE PILL OF IMMORTALITY

(Concluded from page 385)

great sin on my part not to transmit the Tao (Way) which would otherwise be lost to the world forever. I shall not write on silk lest the divine secret be unwittingly spread abroad. In hesitation I sigh. Without cessation I ponder. There are directions for the processes, the more important principles of which shall be set forth but the details shall not be divulged. . . .

"Treatment and mixing will bring about combination and rapid entrance to the scarlet portal. The escape must be firmly blocked. Below plays the dazzling flame, while the Dragon and Tiger keep up a sustained vociferation. The flame at the start should be weak, so as to be controllable, and should be made strong at the end. Close attention and careful watch should be given so as to regulate properly the heat and cold. There are twelve divisions to the cycle. On the completion of the cycle a closer watch should be accorded. As the breath expires, life is ended. Death expels the spirit. The color changes into a purple. Behold! the *Huan Tan* (Returned Medicine) is obtained. This is then made into pills. These are extremely efficacious, although their individual size is so small that they occupy only the point of a knife or the edge of a spatula. . . .

"O, the sages of old! They held in their bosoms the elements of profundity and truth. Having compounded and partaken of the medicines prepared in the nine *Tings* (furnace pots), they were endowed with the power to disappear at will. They held the essence firmly and cultivated their spirit, and they thereby attained communion with the three primes. The essential fluids worked properly to give them fine, strong bones and muscles. . . . In the course of time they became immortals.

"Their sympathy for those of posterity, who might have a liking for the attainment of the *Tao* (Way), led them to explain the writings of old with words and illustrations. They couched their ideas in the names of stones and in vague language so that only some branches, as it were, were in view and the roots were securely hidden. Those who had access to the discourses wasted their own lives over them. The same path of misery was followed by one generation after another with the same failure. If an official, his career was cut short; if a farmer, his farm was cluttered with weeds; if a merchant, his trade was abandoned; if an ambitious scholar, his family became destitute — in the vain attempt. These grieve me and have prompted the present writing. Although concise and simple, yet it embraces the essential points. The appropriate quantities and processes are put down for instruction together with confusing statements. However, the wise man will be able to profit by it by using his own judgment. . . .

"All this is the work of nature and has nothing to do with untoward doings. It is like the fact that the *Ch'i* (Ethereal Essences) of the mountains and the waters rise to give clouds which then become rain. Again, it is like the reduction of mud to give dust and the destruction of fire to give earth.

"The bark of the *Nieh* tree dyes yellow and the *Lan* (indigo) dyes blue; the boiling of hides yields glue; and the *Ch'u Nieh* (yeast) ferments to give liquor. It is easy to get results when the starting materials and the desired products are of the same kind. Otherwise, it is very difficult. . . .

"The aspirant should study this thoughtfully and thoroughly, viewing it from all angles. A thousand readings will bring out some points, and ten thousand perusals will enable him to see. At last revelation will come to bring him enlightenment. Careful study will open the door to the secrets. Nature's *Tao* (Way) shows no partiality, but reveals to all who are worthy."

THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
INVITES YOU AND YOUR FRIENDS TO ATTEND THE
· NINTH ANNUAL OPEN HOUSE ·
SATURDAY MAY 2ND 1931
FROM 2 TO 10 P.M.
CAMBRIDGE MASS

If you hurry

You too may have a set of the Technology Wedgwood Plates for the Summer season.

ONE TECH HOSTESS WRITES:

"Thank you so much for the Technology Plates. Already they have saved a dinner party where a difficult group got so enthusiastic about the plates that the evening was 'made' even before the soup was served."

But besides their conversation-provoking merits they are really beautiful and, of course, Wedgwood. If your order is postmarked by May first, sets may be had at the old prices.

Staffordshire Blue — $13.00 per set of 12
2 sets for $25.00

Mulberry — $15.00 per set of 12

AFTER MAY 1, 1931, *new prices will be effective*

Staffordshire Blue — $14.00 per set of 12
2 sets for $27.00

Mulberry — $16.00 per set of 12

Send orders to THE ALUMNI ASSOCIATION, ROOM 3-225, M. I. T., CAMBRIDGE, MASS.
($4.00 deposit required on all orders)

Additional items in the Wedgwood "Tech" pattern may be had in blue or mulberry to match the Tech plates. Please specify color wanted, enclosing check, or if C. O. D. forwarding deposit of one-half the amount.

Tea Plates	$10.00 per dozen	Tea Cups and Saucers	$10.50 per dozen
Sugar Bowl	3.00 each	Cream Pitcher	1.75 each
Tea Pot	3.50 each	After Dinner Coffees	10.00 per dozen

Meat Platter with Airplane View of Tech (16") $5.00 each

PRICES OF OTHER ITEMS GLADLY QUOTED ON APPLICATION

For merchandize other than Technology plates
Address orders and make checks payable to

JONES-McDUFFEE-STRATTON

367 Boylston Street Boston, Mass.

Let's Go Up to Dennie's Place!

DOUGLAS INN

DOUGLAS HILL, MAINE

(In the Town of Sebago)

340 Acres Woodland Country

Remembered for

Fine Table **Own Farm and Dairy**

Nine-hole Golf Course

Fishing and Hunting

Boating, Bathing

ORVILLE B. DENISON, '11, PROPRIETOR

BELGRAVE PRESS

INCORPORATED

PRINTERS

230 W. 17TH ST. NEW YORK

CHARLES E. FOX, '14
TREASURER

C. H. CARPENTER, '12
SALES

STEAMING UP

(*Continued from page 382*)

or 23% less than in 1922. . . ." These data may be taken as authentic for they are drawn from that incomparable statistical reservoir of the railways, the reports of the Interstate Commerce Commission. But, as a comparative measure of fuel economy between the best engines of 1922 and 1929 they are of no value whatsoever. They do represent most strikingly the decline in the average number of pounds of coal (with other fuels equated) consumed per thousand gross ton-miles of load hauled, including the locomotive itself, its tender and cars, for all the locomotives operating on all the Class I railroads of the United States.

This tremendously gratifying showing is due to a variety of causes such as better organization of the railroads following their return from Federal control, better management, better qualities of coal made possible through advances in mining methods, as well as the modernizing of old locomotives and the replacement of old locomotives by new, modern machines. It might be argued that the number of new locomotives introduced in the last five or ten years has been entirely too small to account for much of the reduction in the average fuel consumption rate. The total inventory of locomotives in use at the beginning of 1931 was 60,400, of which only 4,529 had been purchased within the last five years, and only 12,007 within the last ten years, or 7.5% and 20%, respectively. The records also indicate that the proportion of locomotives ten years of age or less in the total inventory has declined every year since 1911 as compared with the preceding year. In 1911, 61% had been purchased within ten years; at the outbreak of the War, 54%; when the roads were turned back to private ownership, 39%; in 1924, 26%; today 20%.

While numerically true when locomotive units alone are considered, the above data are misleading if locomotive capacities measured by tractive effort or other performance unit be the criterion. The typical "coal hog" purchased during the ten years preceding 1911 is hardly comparable with a typical ten-year old locomotive of the present. Thus the Yearbook of Railroad Information (1930 edition) issued by the Committee on Public Relations of the Eastern Railroads shows that the total number of locomotives in service in 1929 was 1% less than in 1911 but the average power of each unit in service in 1929 was 58% higher than in 1911.

Therefore, just what proportion of the reduction in the average fuel consumption rate may be properly credited to progress in locomotive design as expressed by the introduction of new motive power, or the modernizing of old locomotives retained in service, is somewhat of an open question. Most certainly it would have been greater than it is if the finances of the carriers had permitted them to invest more money in new locomotives. Although the railroads spent about $870,000,000 on improvements during last year, this vast sum had to be spread over various classes of work to none of which could be devoted as much as might profitably have been employed.

It is manifest that, without any further perfection in steam locomotive design, the effect of what is now at hand will, as it is brought more (*Concluded on page 422*)

Books

A Review subscriber asked The Technology Review Book Service to select and obtain for him a sound, readable book on mental diseases. A book on that subject was immediately sent to him and his reaction was expressed in a letter as follows:

"Kindly accept my sincere thanks for prompt and invaluable assistance in obtaining for me exactly the type of book desired. . . . This service alone is worth to me many times the cost of a year's subscription to The Technology Review."

The Technology Review Book Service constantly is rendering service to Review readers. It orders books for them at the published price from publishers the world over, and it searches the second-hand book shops for volumes out of print. For others, like the writer of the adjacent letter, it has the happy opportunity of suggesting desirable books and preparing bibliographies on specific subjects. Readers are urged to avail themselves of its services.

The Technology Review Book Service, Room 11–203, M.I.T., Cambridge, Mass.

STEAMING UP

(Concluded from page 420)

completely into use, insure steam's continued prestige for a long time. The lengthening of engine runs in passenger and freight service accomplished within the past few years illustrates what may be expected from the application of what, so far as engineering skill is concerned, has been at hand a long while. A discussion of the import of extending the accepted distances for locomotive runs, together with a survey of probable future trends in steam locomotive design, will appear in The Review for next July.

BABBLE IN THE AIR

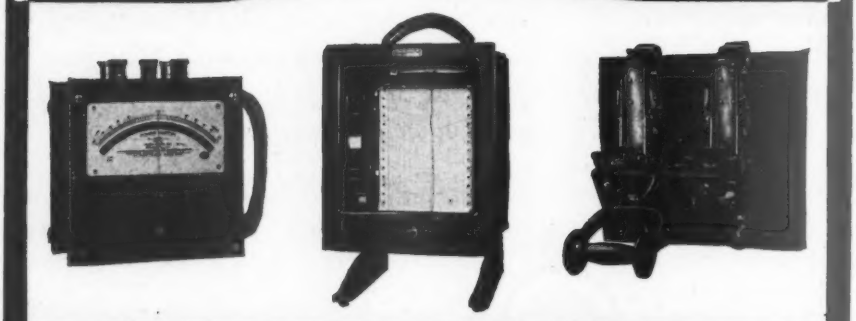
(Continued from page 388)

I believe that those broadcasting features which have the strongest hold on the real interest and affection of the American people are the non-advertising, serious features. Dr. Cadman's and Dr. Fosdick's Sunday afternoon services, the Catholic Truth hours, Seth Parker's Jonesport hymn-singing circle, Walter Damrosch's morning musical talks and illustrations for school children, the Philharmonic concerts, and the like. (I am speaking only of the great chain broadcasts, the only ones I hear.) Next to them come the popular programs of interesting features and good popular music with a minimum of advertising, Amos and Andy, of course, the General Electric hours with Floyd Gibbons and Damrosch, the Lucky Strike dance music, Whiteman's band on a commercial program, the Philco musical period, the Collier's hours, the Jenney band, Big Brother, Kaltenborn Edits the News, and the great, sponsored, athletic broadcasts. None of these deserves Mr. Orton's contempt.

Nearly all local advertising is bad. Snippets of time, too much advertising, cheap talent, the ubiquitous business man insisting on doing his own talking instead of leaving it to an expert announcer, and entertainment "routine" often remarkable for silliness, vulgarity, and ineffectiveness. Almost as bad are the programs arranged for women — commercial shopping advertising which often tries to pass itself off as disinterested expert opinion, high-flown ingenuity in matters of house decoration, novelties in cooking and the like, interspersed with commonplace records. Children's programs are almost invariably fantastic, affected and grotesque, unworthy the attention of an intelligent, normal child. Banks and financial institutions are the worst offenders as to dull and long-winded technical discussions about investment and budgeting. Stray fragments of time are often filled at local stations by improvised frolics and stunts by the studio personnel, dreary beyond belief. Most of this stuff is well below the "thirteen year old" limit Mr. Orton talks about. Were it not for the great chain advertising features, if we had to rely on the local station's economies and improvisations, we should fare badly indeed.

SOME remedies are suggested. It may be that some day we shall have selective programs by wire for which the listener pays a fee, knowing in advance what he is to get. I have been told that people *(Concluded on page 424)*

Use Roller-Smith Apparatus for—
INDICATION REGISTRATION PROTECTION



SATISFACTION is Always the Result

Bulletins covering the various devices will be sent on request

OVER 40 YEARS' EXPERIENCE IS BACK OF

ROLLER-SMITH COMPANY
Electrical Measuring and Protective Apparatus

Main Office: 233 Broadway, NEW YORK
Offices in Principal Cities in U. S. A. and Canada

Works: BETHLEHEM, PENNA.
JOHN R. SANBORN ('04), *Vice-President and General Manager*

ROLLER SMITH

Products
comprise complete lines of
Electrical Instruments
Indicating and Graphic
Circuit Breakers
Air and Oil
Relays
Control Panels

Commercial Photographs
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Portraits and Framing
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TECHNOLOGY PHOTOGRAPHIC and PHOTOSTAT SERVICE
ROOM 11-003—M. I. T.

Special attention given mail orders

Liquid Sulphur Dioxide, SO_2

ESOTOO

TRADE MARK REGISTERED U. S. PATENT OFFICE

for

Refrigeration, Textile and Chemical Uses

Our refrigeration grade EXTRA DRY ESOTOO *is guaranteed to contain not over 50 parts of moisture per million.*

VASO *and* VASITE - *Stripping Agents*

VIRGINIA SMELTING CO.
WEST NORFOLK, VA.

A. H. EUSTIS, *Vice-Pres.*	M. I. T. Special '03
F. A. EUSTIS, *Sec'y-Treas.*	M. I. T. Special '03
C. W. JOHNSTON, *Gen. Manager*	M. I. T. '05
F. W. BINNS, *Engineer and Salesman*	M. I. T. '21

131 State St., Boston and 75 West St., New York, N. Y.

B-I-W
"Quadridge"

Portable
CABLE

QUADRIDGE CORD is identified by four longitudinal ridges in the surface of the rubber and represents a high quality cord made for severe service.

QUADRIDGE CORD is vulcanized in a steel mould under high pressure resulting in a dense, tough, and smooth rubber jacket which offers the best resistance to the twisting, bending, and abrasion of service.

QUADRIDGE CORD is constructed in the sizes and number of conductors that are required for all the various portable electric machinery and appliances for the factory, office, or home.

For a better portable cord, call for

QUADRIDGE

"Quality of product is our first consideration"

BOSTON INSULATED WIRE
and CABLE COMPANY
BOSTON, MASS.

THE PHOENIX BRIDGE COMPANY
PHOENIXVILLE, PA.

Steel Bridges and Buildings

The COPLEY-PLAZA Boston

Recognized as one of the finest hotels in the world, richly furnished, modern in every respect . . . located in historic Copley Square, probably the most accessible and attractive spot in Boston.
Rooms $4 and up.

ARTHUR L. RACE
Managing Director

Tea Dances every Wednesday and Saturday afternoon —4:30 to 7

Supper Dances nightly.

Music, Meyer Davis Le Paradis Band, direction of Joe Smith.

HOTEL OF DISTINCTION

BABBLE IN THE AIR

(*Concluded from page 422*)

are working on a speech-filter which will tune out talking and let only music through — but that seems almost too fantastic. A demand has been made that Congress insist that the F.R.C. clear 15 full channels for educational and governmental use, but there the vested interest of our common law steps in. It has been suggested that every licensed station be required to give up a certain number of hours for non-advertising features supported at its own expense. That would tend, undoubtedly, to force the little incompetent local stations out of business. Most of these seem possible, one or two seem even probable.

I have one suggestion for the music lover who complains of the constant repetition of popular dance music and little good music: It would involve the intelligent use of the phonograph. The music machine, as you know, is under a cloud in radio. Stations are not allowed to play records for more than a stated minimum of time. As usual in America, the emphasis is on the machine and not on the quality of the product. One has only to look at the music section of the *American Mercury* to realize that there are dozens of recordings of great classical and distinguished modern music being made by great musicians and orchestras. These do not belong in the class of records that are played between department store advertising items. They are infinitely better than the general run of music furnished on the air by living musicians, the second-rate trios, and little orchestras and dance bands.

If some intelligent advertiser, or even some intelligent local station, were to announce a regular hour of the very finest recorded music, selected by a musical expert, and were to advertise it so that even people like Mr. Orton could not help finding out about it, large numbers of people would have their music problem solved. At present they are giving up the radio in despair and buying these expensive records. A good record would certainly go on the air as perfectly as a mediocre assemblage of studio musicians. Advertise it deliberately as a "high-brow" musical program, intended to bring cultivated people back to the radio. It might have some result!

ROTOGRAVURE PRINTING

A Complete Rotogravure Department, the first installation in New England by a commercial printing firm, is now in full operation at our plant. This new department is equipped to produce ROTOGRAVURE PRINTING in any desired form and quantity. A complete service, including photography, art work and copy writing, is available. It is our intention to produce ROTOGRAVURE PRINTING of quality comparable to that of our book, catalog and general commercial printing.

THE MURRAY PRINTING COMPANY
KENDALL SQUARE · CAMBRIDGE

TELEPHONE 5650 UNIVERSITY

A YOUNG MAN'S BUSINESS
THAT EARNS UPWARDS OF
$5000 A YEAR

START MAKING MONEY from the beginning. Young college engineers, new graduates and alumni interested in the construction field can start out working for themselves—and earn upwards of $5000 a year in Crane Service—a self-owned, self-bossed business which yields big returns on a small investment. Not a sales job—actual construction work. Interesting details available. Address:

CRANE SERVICE ASSOCIATION, Lorain, Ohio

IMPORTANT MESSAGE *to the* ENGINEER

THE TECHNOLOGY BRANCH is operated for students and men of the engineering profession. We are in a position to save you money on numerous articles. If you are contemplating the purchase of any article listed below, check the coupon, mail it to us, and we will gladly quote you a price and description. We guarantee absolute satisfaction and if not satisfied we will refund your money on any purchase made.

SLIDE RULES

The Log Log Vector for the Electrical Engineer has proved a success.

We also stock the

MANNHEIM, POLYPHASE POLYPHASE DUPLEX AND LOG-LOG DUPLEX

THE NEW POLYPHASE POCKET RULE is growing more popular daily. This rule has all the scales of the large rule including cubes and cotangents. Size overall 1¼ in. wide x 6 in. long x ⅛ in. thick. About the size of a pocket comb.

PORTABLE TYPEWRITERS

We are featuring a new improvement for the special TECH ENGINEERING KEYBOARD. This feature improves the efficiency about 25%.

TECH SEAL BOOK ENDS

We have recently received a shipment of these made from a new die. The seal is the best we have ever sold.

TECH SEAL PLAQUES

The seal on this plaque is made from a new die and is the best we have ever carried.

DRAWING INSTRUMENTS

Paragon and Key — Other sets can be furnished

FOR GIFTS—*We Suggest*

TECH SEAL JEWELRY. WATCH CHARMS, PINS, ASH TRAYS, POCKET KNIVES, LIGHTERS, COMPACTS, PAPER WEIGHTS, RINGS

TECHNOLOGY BRANCH
Harvard Cooperative Society
76 Massachusetts Avenue, Cambridge, Mass.

Gentlemen: I am interested in the article listed below. Without obligation on my part please furnish description and price of same.

Article.....

Name.....

Street.....

City.....*State*.....

An Unusual Display

of

Summer Furniture

is ready for your

Inspection

at

WILLIAM LEAVENS & CO., INC.

32 Canal Street, Boston

at Haymarket Square

F B&D

M. I. T. MEN

H. V. Coes - - - - '06
E. S. Coldwell - - '15
S. J. Cole - - - - - '26
J. A. Emery - - - - '93
Page Golsan - - - '12
J. F. Greene - - - '07
F. K. Merriman - '04
G. I. Rhodes - - - '05
A. A. Uebelacker - '18
R. P. Westerhoff - '27
H. E. Whitaker - - '09
J. E. Woodbridge '93

Design
Construction
Management
Reports

Ford, Bacon & Davis, Inc.
Engineers
39 Broadway, New York City
Philadelphia Chicago San Francisco

THE INSTITUTE GAZETTE

(*Continued from page 404*)

The Commemorative Tablets

IN THE report of the committee to make recommendations on suitable inscriptions in the new dormitories mentioned last month was included the wording of the tablets to be placed in the lounge or Burton Room.

The commemorative tablets exhibit the following inscriptions:

CHARLES WARREN GOODALE '75
BUTTE, MONTANA.
A PIONEER IN THE DEVELOPMENT OF MINING IN THE WEST,
HE RETURNED TO BRING THE FRUITS OF HIS LABORS TO
THE INSTITUTE THAT TRAINED HIM

JAMES PHINNEY MUNROE '82
BOSTON, MASS.
EDUCATOR, MANUFACTURER, PUBLICIST AND WORKER
IN MANY NOBLE CAUSES.
A MEMBER OF THE CORPORATION AND LONG ITS
SECRETARY,
A DEVOTED ALUMNUS WHO RENDERED INVALUABLE SERVICE
TO HIS ALMA MATER

CHARLES HAYDEN '90
NEW YORK CITY.
BANKER, PATRON OF ARTS AND INDUSTRY.
MEMBER OF THE CORPORATION.
A FINANCIER WHOSE VISION ADVANCED
PROSPERITY, AND WHOSE UNKNOWN BENEVOLENCES
TO TECHNOLOGY AND BEYOND ITS DOORS AIDED
YOUNG MEN TO SELF-RELIANCE AND SUCCESS

ALBERT FARWELL BEMIS '93
BOSTON, MASS.
PUBLIC SPIRITED CITIZEN AND BUSINESS MAN,
ENGAGED IN MANIFOLD ACTIVITIES.
MEMBER OF THE CORPORATION.
AN ALUMNUS WITH GLOBE-ENCIRCLING INTERESTS,
YET FINDING HIS HIGHEST ENJOYMENT IN QUIET
SERVICE FOR STUDENT ADVANCEMENT AT M.I.T.

KENNETH FOSTER WOOD '94
CENTRAL FALLS, R. I.
ENGINEER, MANUFACTURER AND ADMINISTRATOR OF
THE GREAT BASIC TEXTILE INDUSTRY.
KEENLY INTERESTED IN YOUTH, HE GAVE GENEROUSLY
THAT FUTURE GENERATIONS OF STUDENTS MIGHT HAVE
LIFE MORE ABUNDANTLY

WILLIAM WRIGHT WALCOTT '01
NATICK, MASS.
SKILLFUL PHYSICIAN AND EFFICIENT
STATE HEALTH OFFICIAL.
CAPTAIN IN THE U. S. MEDICAL CORPS IN
THE WORLD WAR,
HE LOST HIS OWN LIFE IN MINISTERING TO HIS
FELLOW MEN ON THE BATTLEFIELDS
OF FRANCE

The inscription on the Burton Tablet is as follows:

BURTON ROOM
NAMED IN HONOR OF
ALFRED E. BURTON
FIRST DEAN OF THE INSTITUTE.
FOUNDER OF STUDENT GOVERNMENT AND THE
DORMITORY SYSTEM AT TECHNOLOGY.
A MAN BELOVED BY EVERY STUDENT AND ALUMNUS.

(*Concluded on page 428*)

Air view of mid-town New York taken from directly over The SHELTON

© Curtiss Flying Service, Inc.—Photo Division

The Heart of New York, The SHELTON ZONE

Most people who visit New York

—*spend their days and nights in the mid-town section*

It is the center of uptown business life—the shopping district—and the theatrical and night life metropolis of the world. *The* SHELTON, with its many other attractions besides convenience to these activities, has become one of the most popular of hotels among visitors to the city. In addition to supplying every possible hotel service, it gives its guests an atmosphere of quiet and comfort and hospitality that is most unusual to find in a metropolitan hotel. You'll enjoy a visit to *The* SHELTON.

Room for one, $3 to $6
Room for two, $6 to $9

The SHELTON *Swimming Pool may be used by all guests, at all times, without charge.*

The SHELTON

49th and Lexington Ave. New York

5 minutes from Grand Central Station—convenient to all business, shopping and theatrical activities in mid-town New York

Walker Memorial Dining Service

Meals Served During the Academic Year for Any Type of Technology Alumni Gathering

CLASS DINNERS GIVEN SPECIAL ATTENTION

The recreational facilities can be made available if desired

Menus submitted upon request

Address

A. W. Bridges, Walker Memorial, M. I. T., Cambridge, Mass.

New England Coal & Coke Co.

"The House of Service"

NEW RIVER POCAHONTAS

• COALS •

STOKER *and* SLACK *for* Powdered Fuel Plants *and* Automatic Stokers

250 STUART STREET • BOSTON, MASS.

William H. Coburn & Co.

Investments

68 Devonshire St. Boston, Mass.

THE INSTITUTE GAZETTE

(Concluded from page 426)

The general dedication tablet is as follows:

DEDICATED
IN GRATEFUL APPRECIATION
TO
THE ALUMNI
OF THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
WHOSE GENEROUS CONTRIBUTIONS
MADE POSSIBLE
DURING THE PRESIDENCY OF SAMUEL WESLEY STRATTON
THE PROVISION OF THIS QUADRANGLE,
THAT STUDENTS MIGHT HAVE
COMFORTS AND CONVENIENCES IN THEIR WORK,
A BROADER SOCIAL CONTACT
IN THE COMPANIONSHIP OF THEIR FELLOWS,
AND A LARGER SHARE IN THE
UNDERGRADUATE LIFE
OF THE
STUDENT BODY.

11,000 TONS ON WHEELS

(Concluded from page 401)

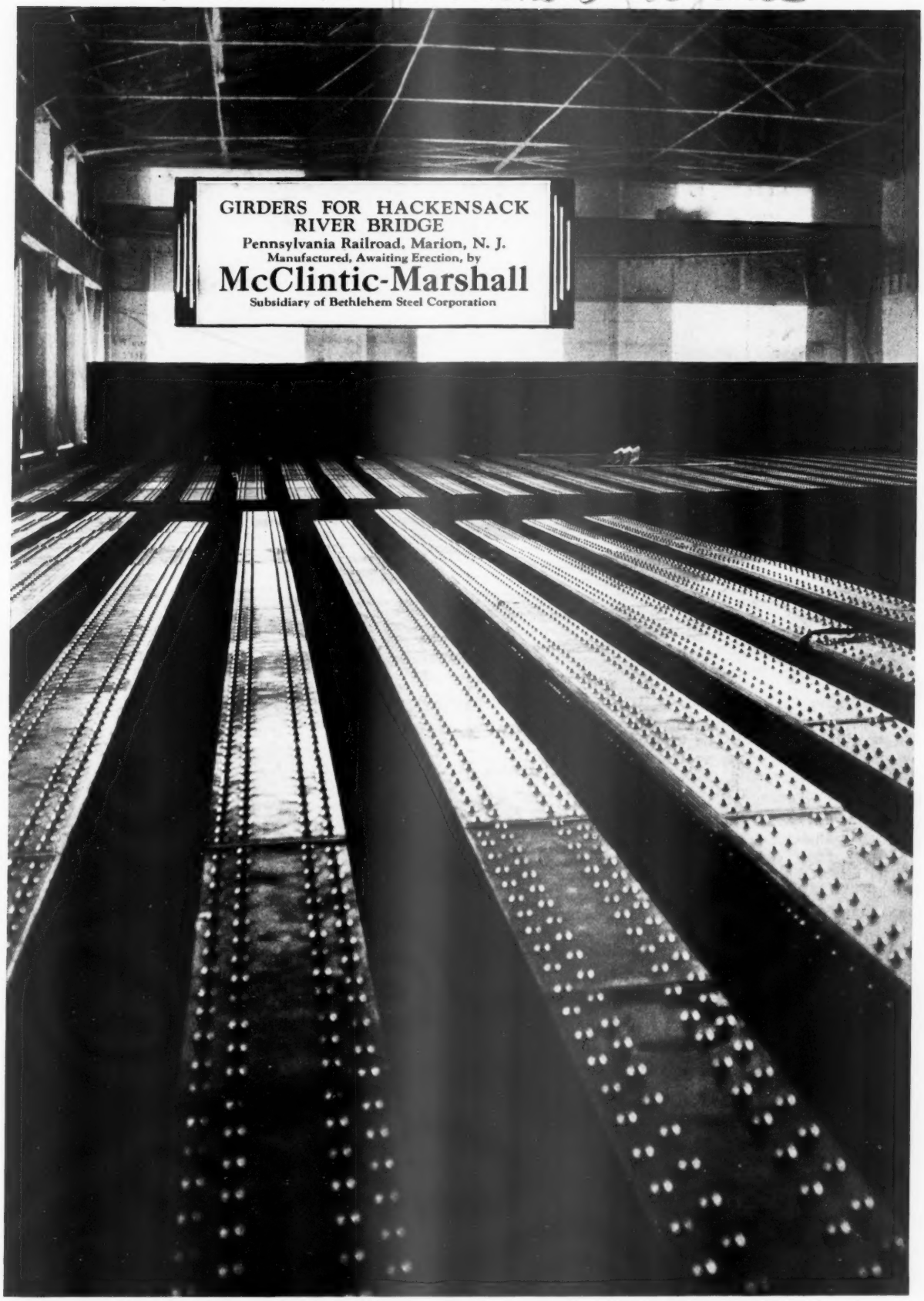
to the column. The space between the column base and the previously placed grillage was then grouted, and allowed to set for three days during which time four jacks supported the column load. One of the popular brands of quick setting cements was used for the grout. With the columns supported on their new footings, the basement walls, floors and partitions were reconstructed and the various house services and telephone cables restored to a permanent condition.

During the entire moving operation there was never any indication of nervousness on the part of the Telephone Company's employees, nor was it possible to detect a feeling of motion while standing on one of the upper floors of the building. Another interesting feature was the fact that most of the "tell-tale" paper strips placed across the plaster cracks throughout the building before the first column was lifted, were still intact and held by the plaster at the end of the operation. The word "most" has been used advisedly, since during the first lifting operation the men were a bit anxious and overjacked several columns. One of these columns was lifted ¾ inch which naturally caused cracks to open in the plaster, these, however, closing again when the column rested on the rollers.

Perhaps the finest compliment the job could receive was that expressed by Mr. Vance Oathout, chief engineer of the Indiana Bell Telephone Company: "The building had been moved as planned, placed on the exact spot indicated, within the time schedules, within the cost estimates, without interruption to service, and without a mishap."

The work was under the supervision of Mr. Oathout and Mr. E. B. Webb, Building and Equipment Engineer, with the aid of Vonnegut, Bohn and Mueller, Architects; Voorhees, Gmelin and Walker, Consulting Architects, H. G. Balcom, Moran and Proctor, and Bevington-Williams, Inc., Consulting Engineers. The General Contractor was Leslie Colvin of Indianapolis and the subcontractor for the structural steel and moving operation was John Eichley, Jr. Company, of Pittsburgh, Pa.

No number published for June



T. J. Skillman, *Chief Engineer*, Pennsylvania Railroad Company A. R. Wilson, *Engineer of Bridges and Buildings*

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THE TABULAR VIEW

OTHMAR H. AMMANN, author of "Brobdingnagian Bridges" on page 441, is internationally distinguished as a bridge engineer. He has been connected in various capacities with the investigation, design, and construction of such famous structures as Queensboro Bridge, the Quebec Bridge across the St. Lawrence River, the arch bridge across the St. John River for the Provincial Government of New Brunswick, the bridge of the C. & O. railroad at Sciotoville, Ohio, and as assistant chief engineer for the design and construction of the Hell Gate Bridge over the Hudson at 57th Street, New York. From 1923 to 1925 he was construction engineer for New York City, from which position he was appointed Chief Engineer of Bridges of the Port of New York Authority. In this new position he was in general charge of the planning and construction of the Outerbridge Crossing over the Arthur Kill, the Goethals Bridge, the arch bridge across the Kill van Kull, and the suspension bridge across the Hudson between Fort Washington, N. Y., and Fort Lee, N. J. He is also a member of the board of engineers for the proposed bridge to span the Golden Gate at San Francisco, the greatest project of its kind conceived by engineers. Since 1930, he has been Chief Engineer of the Port of New York Authority in charge of planning, construction, and maintenance of all its projects, including preliminary studies for the suggested vehicular tunnel under the Hudson at Weehawken, and for various terminal projects. ¶ Mr. Ammann is a native of Switzerland and a graduate in civil engineering of the Swiss Polytechnic Institute at Zurich in 1902. He came to the United States two years later and became a citizen in 1924. In 1918 he was awarded the Thomas Fitch Rowland prize of the American Society of Civil Engineers for his paper on the Hell Gate Bridge and Approaches, and this June he received the degree of doctor of engineering from New York Univsity. His article in this issue is the outgrowth of an Aldred Lecture delivered by Mr. Ammann at the Institute during the past year.

"OUR race has lived on earth for at least a million years, and for only 5,000 years have there been any written records to tell us the kind of man who lived here. For all the rest of this time, if we would rebuild the picture of his life, we must depend on the fragments he left behind him, and of these, the least fragmentary are the remains of his stone construction." For all these many

(Continued on page 436)

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Revolving at 9000 surface feet a minute, speed of a mile every 35 seconds, the grinding wheel attacks and removes the outer shell of the virgin steel billets.

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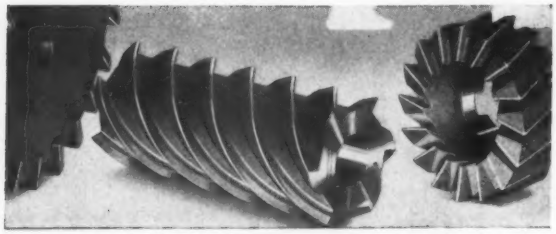

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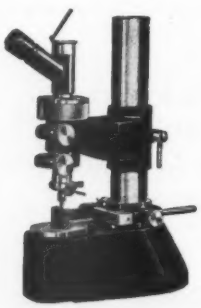

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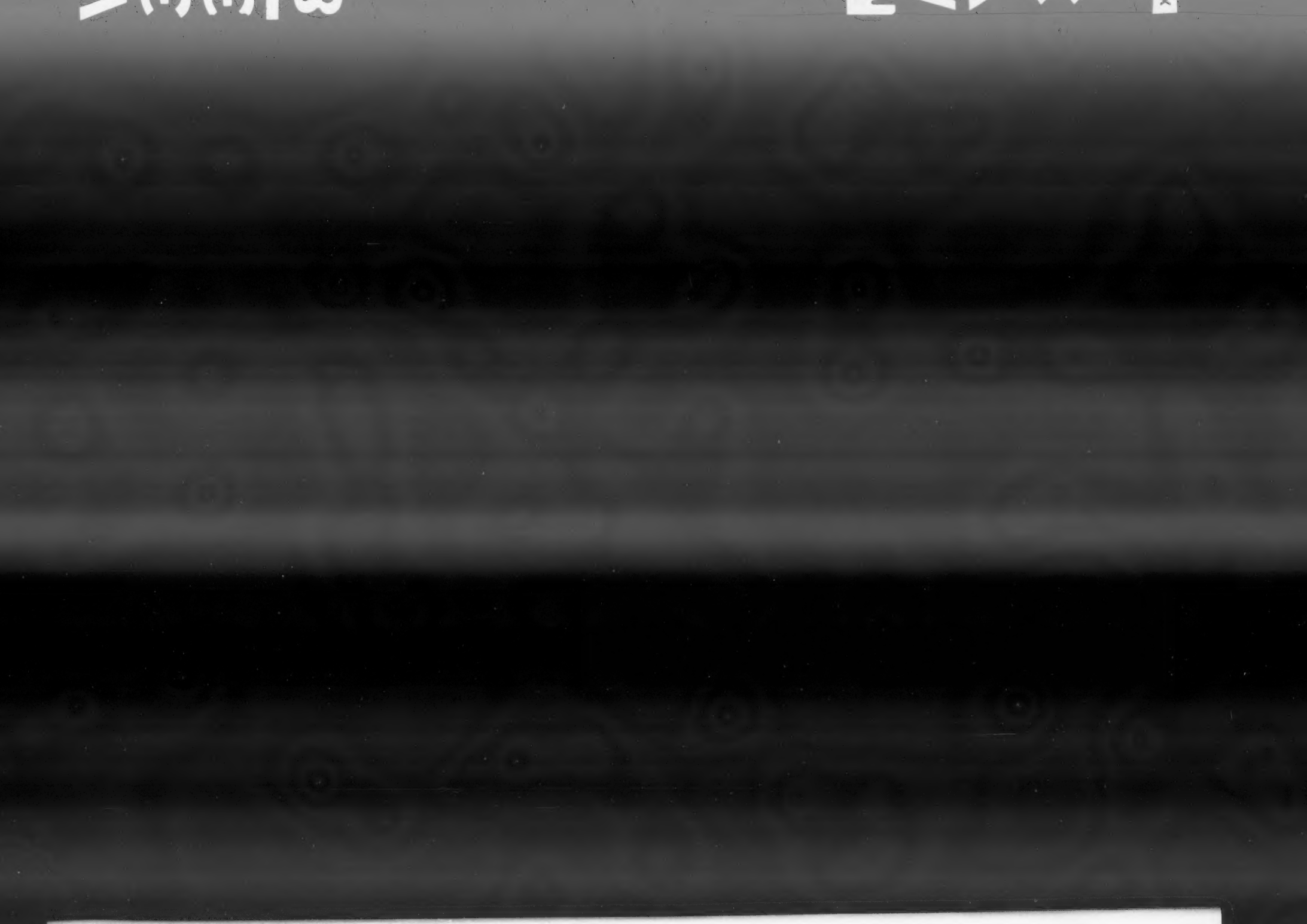
THE TABULAR VIEW

(Concluded from page 434)

years of construction there is no adequate history for the layman, and in his article appearing on page 445, THOMAS F. MCSWEENEY ably sets forth the need for such a History of Building Construction. His is the voice of a builder, and the builder's voice has been long in making itself heard. The history of his profession is Mr. McSweeney's hobby and he has collected a large library on the subject. This year he has been giving a course on his favorite topic to students in the Department of Building Construction at the Institute. Mr. McSweeney is himself a graduate of the Institute in the class of 1916, obtaining his bachelor's degree from the Department of Sanitary Engineering. Until recently, he was Vice-President and General Manager of the Pilgrim Granite Corporation. ¶ The illustrations for this article were done by DAVID J. ABRAHAMS, Class of 1922, a Boston architect. Curiously enough, Mr. Abrahams received his Institute degree in the Department of Engineering Administration. He became interested in architecture after he accepted a position selling building materials, and trained himself for this specialized profession by self-study, special work in the Institute's Department of Architecture, and by taking evening courses in the Lowell Institute School.

HAROLD E. LOBDELL contributes the second and last of his papers on the development of the locomotive. For those who are reading these columns with no intimate acquaintance with the Institute, Mr. Lobdell, Class of 1917, is Dean of Undergraduates at Technology, Publisher of The Review, and has an especially acute interest in railroads and their problems. His interest in this form of motive power vies with that of Edwin H. Whitney of Rehoboth, Mass., who is a famous student of the locomotive.

OTHER contributors to the July issue are Messrs. SAMUEL H. CALDWELL and HAROLD L. HAZEN, instructor and Assistant Professor respectively, in the Department of Electrical Engineering. They are both graduates of the Institute, Mr. Caldwell in the Class of 1925 and Mr. Hazen in the Class of 1924. ¶ The cover of this issue is a reproduction of a copyrighted painting, entitled "The Skull Cracker," by GERRIT A. BENEKER.

AN announcement last month in New York of an electric, pipeless organ invented by RICHARD H. RANGER, '11, recalls another electrical musical instrument described in the May, 1930, Review. We refer to the instrument developed by ARTHUR C. HARDY, '18, under the supervision of du Val R. Goldthwaite. There is reason to believe that future orchestras will be composed of various electrical instruments, and musical composition may then be entirely altered to fit these devices.

WITH this issue The Review closes Volume XXXIII. The next issue you will receive will be the October number, which goes in the mails on the 27th of September. The Review is not published in August and September.